

The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The First Meeting of the Indiana Section

H. T. Davis (Secretary-Treasurer)

To cite this article: H. T. Davis (Secretary-Treasurer) (1925) The First Meeting of the Indiana Section, *The American Mathematical Monthly*, 32:1, 37-37, DOI: [10.1080/00029890.1925.11986403](https://doi.org/10.1080/00029890.1925.11986403)

To link to this article: <https://doi.org/10.1080/00029890.1925.11986403>



Published online: 06 Mar 2018.



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THE FIRST MEETING OF THE INDIANA SECTION.

An Indiana Section of the Mathematical Association of America was reorganized, after a lapse of several years, at a meeting held in the Shortridge High School, Indianapolis, Indiana, on October 16, Professor F. H. Hodge presiding.

The attendance was twenty, including the following nineteen members of the Association:

W. C. Arnold, Gladys Banes, G. E. Carscallen, H. T. Davis, S. C. Davisson, J. E. Dotterer, E. D. Grant, H. E. H. Greenleaf, L. Hadley, D. F. Heath, Cora B. Hennel, F. H. Hodge, E. N. Johnson, June M. Lutz, T. E. Mason, A. Miller, G. E. Moore, C. K. Robbins, and H. N. Wright.

An organization was effected and the following officers elected: Professor F. H. HODGE, Purdue University, Chairman; Professor E. N. JOHNSON, Butler College, Vice-Chairman; Professor H. T. DAVIS, Indiana University, Secretary-Treasurer, these officers to constitute the executive committee of the section. The next meeting will be held early in the year at Purdue, the date to be decided later by the executive committee.

The program consisted in an address by Professor L. Hadley of Purdue on the subject: "How the state requirement in commercial arithmetic is handled by Purdue"; this was followed by a stimulating discussion.

H. T. DAVIS, *Secretary-Treasurer.*

QUESTIONS AND DISCUSSIONS.

EDITED BY C. F. GUMMER, Queen's University, Kingston, Ont., Canada.

The department of Questions and Discussions in the MONTHLY is open to all forms of activity in collegiate mathematics, including the teaching of mathematics, except for specific problems, especially new problems, which are reserved for the separate department of Problems and Solutions.

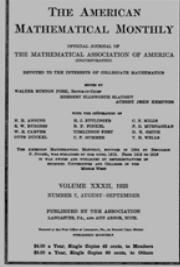
DISCUSSIONS.

I. NOTE ON MR. WEAVER'S PAPER "A SYSTEM OF TRIANGLES RELATED TO A PORISTIC SYSTEM" (1924, 337-340).

By F. D. MURNAGHAN, Johns Hopkins University.

The object of this note is to show that the interesting results in Mr. Weaver's paper may be derived in a different manner possessing a certain interest of its own.

The three vertices of any triangle may be fixed by means of a complex variable or, what is much the same thing, a polar coördinate system whose origin may be taken at the center of the circumcircle of the triangle. Denoting the radius of this circumcircle by R , the three vertices are $z_1 = Rt_1$, $z_2 = Rt_2$ and $z_3 = Rt_3$ respectively, where t_1, t_2, t_3 are turns or complex numbers of unit modulus. Let us consider two points y and x_1 which are images of each other in the straight line joining the points z_2 and z_3 . The quotients $\frac{y - z_2}{y - z_3}$ and $\frac{x_1 - z_2}{x_1 - z_3}$ are, therefore,



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The May Meeting of the Indiana Section

H. T. Davis (Secretary)

To cite this article: H. T. Davis (Secretary) (1925) The May Meeting of the Indiana Section, The American Mathematical Monthly, 32:7, 333-335, DOI: [10.1080/00029890.1925.11986470](https://doi.org/10.1080/00029890.1925.11986470)

To link to this article: <https://doi.org/10.1080/00029890.1925.11986470>



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the Gaussian scale corresponding to the individual animals considered as the extreme individuals in a frequency distribution of a large population.

BESSIE I. MILLER, *Secretary-Treasurer.*

THE MAY MEETING OF THE INDIANA SECTION.

The second meeting of the Indiana Section of the Mathematical Association of America was held May 8-9, 1925, at Indiana University, Bloomington, in connection with the visit of Professor J. HADAMARD of Paris to this institution.

There were forty-three present including the following thirty members of the Association: R. J. Aley, Gladys L. Banes, C. F. Barr, J. C. Bennett, E. M. Berry, H. T. Davis, S. C. Davisson, C. S. Doan, J. E. Dotterer, W. E. Edington, E. D. Grant, G. H. Graves, J. Hadamard, L. Hadley, U. S. Hanna, C. T. Hazard, Cora B. Hennel, F. H. Hodge, E. N. Johnson, J. J. Knox, Florence Long, Juna M. Lutz, Wm. Marshall, T. E. Mason, G. E. Moore, C. K. Robbins, D. A. Rothrock, K. P. Williams, H. E. Wolfe, H. N. Wright.

On Friday evening the visiting members were present at a joint dinner of the Indiana and Purdue sections of the American Association of University Professors.

At eight o'clock Professor Hadamard gave an address under the auspices of the Indiana chapter of Sigma Xi on the subject: "The equilibrium of the solar system, past and future." The introduction was made by Professor S. C. Davisson of Indiana University.

Professor Hadamard first discussed the nature of the motions of the planets of the solar system and pointed out that the greatest cause for perturbations in the orbits of the planets is the mass of Jupiter. Although these disturbances are largely compensating, there still remains a small residual disturbance which may ultimately lead to the disintegration of the solar system. The speaker showed how the study of this problem can be based upon geometrical analogy.

The program Saturday morning consisted of an address by Professor Hadamard on the subject: "The modern notion of a function." The speaker first showed how the notion of functional relationship soon outgrew Euler's definition of "functio continua." He then pointed out that analytic functions, as a class, possess three fundamental properties. First: they can be represented by means of formal expressions. Second: they possess the group property, *i.e.*, that an analytic function of an analytic function is again an analytic function. Third: they possess the property of continuation. The speaker then inquired whether other classes of functions might not exist which would fail to have one or more of these properties, but would still possess the others. Such a class is furnished by those functions which admit the limitation $|f^{(n)}| < k^n(an)! \quad a > 1$. Functions thus characterized arise in the parabolic case of the boundary-value problem of partial differential equations and are called *quasi-analytic*. As a class, they fail to possess the third property of analytic functions. The work of Gevrey, Denjoy and Carleman was quoted.

After a short business session presided over by the chairman, Professor F. H. Hodge of Purdue University, adjournment was taken to the university cafeteria where a luncheon was served to the members and their guests.

The afternoon program consisted of the following papers:

1. "Characteristic errors in the algebra of college freshmen" by Mr. C. F. BARR of Purdue University.
2. "A simple demonstration of some lemmas of Jensen" by Professor K. P. WILLIAMS of Indiana University.
3. "What college teachers can do to improve the quality of mathematics in the secondary schools" by Professor J. E. DOTTERER of Manchester College.
4. "The solution of triangles from an algebraic point of view" by Professor C. K. ROBBINS of Purdue University.
5. "Projective geometry as an undergraduate study" by Professor H. N. WRIGHT of Earlham College.
6. "The history and present status of integral equations" by Professor H. T. DAVIS of Indiana University.

Abstracts of the papers follow, the numbers corresponding to the numbers in the list of titles:

1. Mr. Barr presented the results of a statistical study of characteristic errors in the algebra of college freshmen based on the results of an examination of several hundred semester examination papers. The solution of linear simultaneous equations in two unknowns appears to be the easiest problem for freshmen, while the simplification of continued fractions and the determination of parameters present the greatest difficulty.

2. In his paper Professor Williams gave a simple and direct demonstration of the lemmas that form the basis for some of Jensen's theorems on analytic functions.

3. Professor Dotterer made a plea for a better supervision of the preparation of high school teachers of mathematics and suggested the coöperation of the Indiana Section of the Association with the State Board of Education. Upon motion, the chairman was instructed to appoint a committee to study the problem and present suggestions to the state board.

4. In the case of plane triangles Professor Robbins assumed the law of sines and then used the system: (1) $b/a = \sin B/\sin A$, (2) $c/a = \sin C/\sin A$, (3) $A + B + C = \pi$, to obtain by purely algebraic means the other formulas used in plane trigonometry. A similar derivation of the formulas of spherical triangles was made.

5. Professor Wright stated that an examination of the courses of study of a number of the leading colleges and universities of the country shows that courses for undergraduates in synthetic projective geometry are offered in about half of them. In this subject, better than any place in the usual undergraduate course, there is available to the student of elementary mathematics a most interesting presentation of some of the great concepts and unifying principles of geometry.

It should be included in the training of all prospective teachers and majors in mathematics.

6. The paper of Professor Davis, based upon a bibliography of 500 titles, traced the development of integral equations during the twenty-five-year period since the appearance of Fredholm's first paper in 1900.

The time and place of the next meeting were left for the decision of the executive committee.

H. T. DAVIS, *Secretary.*

THE DECEMBER MEETING OF THE MARYLAND-VIRGINIA-DISTRICT OF COLUMBIA SECTION.

The sixteenth regular meeting of the Maryland-Virginia-District of Columbia Section was held at Johns Hopkins University, Baltimore, Md., on December 6, 1924. The members were the guests of the University at luncheon. There were two sessions; Dr. F. D. Murnaghan presided at each session.

The attendance was forty-five including the following thirty-two members of the Association: O. S. Adams, R. N. Ashmun, H. G. Avers, Clara L. Bacon, W. W. Bigelow, G. A. Bingley, C. C. Bramble, J. A. Bullard, P. Capron, G. R. Clements, A. Cohen, J. B. Eppes, H. Gwinner, W. M. Hamilton, L. S. Hulbert, W. D. Lambert, A. E. Landry, Florence P. Lewis, E. S. Mayer, F. D. Murnaghan, J. R. Musselman, C. A. Nelson, C. H. Rawlins, Jr., J. N. Rice, H. M. Robert, Jr., A. C. Robinson, H. A. Robinson, R. E. Root, G. A. Ross, J. B. Scarborough, Elizabeth W. Wilson, E. W. Woolard.

The following nine papers were read:

- (1) "The slighted pyramid" by Professor HARRY GWINNER, Vice Dean, University of Maryland.
- (2) "Needs of symbols for partial and total differential coefficients" by Professor A. COHEN, Johns Hopkins University.
- (3) "On the Jonquières curve" by Dr. C. A. NELSON, Johns Hopkins University.
- (4) "The distance between two points on an ellipsoidal earth" by Mr. W. D. LAMBERT, U. S. Coast and Geodetic Survey.
- (5) "The summation method for the determination of the Pearsonian coefficient of correlation" by Miss ELIZABETH W. WILSON of the Central High School, Washington, D. C.
- (6) "Parametric equations of the perimeter of regular polygons" by Dr. O. S. ADAMS, U. S. Coast and Geodetic Survey.
- (7) "A geometrical discussion of right-angled triangles with integral sides" by Mr. R. L. CARY of Baltimore, Md.
- (8) "A laboratory course in mathematics" by Professor R. E. ROOT, U. S. Naval Academy.
- (9) "A mathematical instruments laboratory" by Professor C. C. BRAMBLE, U. S. Naval Academy.



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The Third Meeting of the Indiana Section

H. T. Davis (Secretary-Treasurer)

To cite this article: H. T. Davis (Secretary-Treasurer) (1926) The Third Meeting of the Indiana Section, *The American Mathematical Monthly*, 33:8, 395-397, DOI: [10.1080/00029890.1926.11986606](https://doi.org/10.1080/00029890.1926.11986606)

To link to this article: <https://doi.org/10.1080/00029890.1926.11986606>



Published online: 06 Mar 2018.



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THE THIRD MEETING OF THE INDIANA SECTION.

The third meeting of the Indiana Section of the Mathematical Association of America was held May 7 and 8, 1926, at Purdue University.

There were forty present at the meeting including the following thirty-one members of the Association: W. C. Arnold, Gladys L. Banes, C. F. Barr, J. C. Bennett, E. M. Berry, E. P. Blackburn, S. Bolks, G. E. Carscallen, H. T. Davis, S. C. Davisson, J. E. Dotterer, W. E. Edington, P. D. Edwards, E. D. Grant, G. H. Graves, H. E. H. Greenleaf, L. Hadley, C. T. Hazard, Cora B. Hennel, F. H. Hodge, E. N. Johnson, J. J. Knox, Florence Long, Juna M. Lutz, W. Marshall, T. E. Mason, J. C. Nixon, C. K. Robbins, R. B. Stone, H. N. Wright, W. A. Zehring.

On Friday evening the visiting members were entertained at a joint dinner given at the Purdue Union by the Purdue chapters of Sigma Xi and the American Association of University Professors in honor of Professor F. R. Moulton of the University of Chicago, national president of Sigma Xi.

At eight o'clock Professor Moulton gave an illustrated lecture on the subject: The Origin and Evolution of Worlds. The nature and origin of the solar system and the structure of the galaxy were discussed in Professor Moulton's entertaining style. The address concluded with a statement of the possibility of the existence of super galaxies of which the spiral nebulae form atomic particles.

At the session on Saturday morning presided over by Professor F. H. Hodge of Purdue, chairman, a constitution for the section was adopted and the following officers elected: Professor E. N. JOHNSON, Butler College, chairman; Professor J. E. DOTTERER, Manchester College, vice chairman; Professor H. T. DAVIS, Indiana University, secretary-treasurer.

Professor Johnson presented a report by the committee on requirements for high school teachers which was adopted. A discussion of this report, prepared by Professor D. A. Rothrock of Indiana University was read, in the absence of Professor Rothrock, by Professor W. E. Edington of Purdue. Professor S. C. Davisson of Indiana University discussed the question of the segregation of superior and inferior students. Mr. C. F. Barr of Purdue in continuing the discussion showed how the Iowa placement tests in mathematics could be used as a tool in making student classifications at the time of their entrance. A study made by correlating the grades obtained on the placement test and the grades recorded in the mathematics department at Purdue showed a correlation coefficient of $.741 \pm .015$ with the data grouped in five-unit intervals.

The meeting then adjourned to the Purdue Union where a luncheon was served to the members and their guests.

The afternoon program consisted of the following papers:

- (1) "The construction and use of orthogonal and biorthogonal functions," by Professor H. R. MATHIAS, Indiana Central College. (Introduced by Professor Davisson).
- (2) "A certain general type of contact transformation," by Professor C. K. ROBBINS, Purdue University.
- (3) "The summation of series," by Mr. H. A. ZINSZER, Indiana University. (Introduced by Professor Davis).
- (4) "The fractional calculus," by Professor H. T. DAVIS, Indiana University.
- (5) "The true transition curve and some of its approximations," by Dr. E. M. BERRY, Purdue University.
- (6) "Characteristic algebraic errors of college freshmen (second Paper)" by Mr. C. F. BARR, Purdue University.

Abstracts of the papers follow, the numbers corresponding to the numbers in the list of titles.

1. Professor Mathias showed how a set of normalized orthogonal functions could be built up in a given interval from a set of n linearly independent functions and indicated the nature of the expansion problem associated with such sets.

2. Professor Robbins showed that $x' = f_1(x, y, p)$, $y' = f_2(x, y, p)$, $z' = f_3(x, y, p)$ is a contact transformation if the vanishing of $dy' - p dx'$ is a consequence of the vanishing of $dy - p dx$. This condition leads to a set of partial differential equations which can be easily solved in special cases. The ordinary dilation is obtained by a proper specialization of the arbitrary functions involved.

3. Making use of fundamental properties of the operator $\theta = x \frac{d}{dx}$, Mr. Zinszer developed several methods for summing series. These methods were concerned with the establishing of a differential equation whose solution is the sum of the given series. Various ways of deriving the differential equation from the given series were discussed and examples given to illustrate the theory.

4. Professor Davis discussed the nature of problems which come naturally under the discipline of a calculus founded on fractional operations. Methods for solving various types of fractional equations were discussed. It was pointed out that many of the expansions obtained in the application of the Heaviside operational calculus to electrical circuit theory are special cases under the calculus of fractional operators.

5. Dr. Berry showed that for a railroad the true transition curve from straight track to circular track is such that the curvature is proportional to the distance traversed, measured from the end of the straight track. The coordinates were obtained as Fresnel's integrals and the curve was shown to be Cornu's spiral found in connection with the theory of the diffraction of light.

Near the origin a cubical parabola and a lemniscate are two approximations; for large distances from the origin a lituus is a good approximation.

6. Mr. Barr's paper was a continuation of a study presented at the last meeting of the Indiana section. The data were collected from a study of 1000 semester examination papers written under twenty instructors. The results indicated that probably too much time was being given to re-mastering material of high school grade and too little time to actual mastery of algebra of college grade.

The time and place of the next meeting were left to be decided by the executive committee.

H. T. DAVIS, *Secretary-Treasurer.*

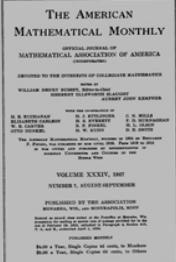
ORIGINS OF FOURTH DIMENSION CONCEPTS

By FLORIAN CAJORI, University of California

1. **From Aristotle to Henry More.** Inquiries into the possibility of a fourth dimension of space reach as far back as Greek philosophy. Nevertheless, for 2000 years no one dared to proclaim the existence of such a space. Thus Aristotle in his *Heaven* says that a solid has magnitude "in three ways and beyond these there is no other magnitude because the three are all." This is the record of man's observation and every-day experience in our physical universe. In his *Metaphysics* [1066b32] he speaks of a body as "that which has dimension every way"; in his *Physics* [IV, 1] when considering motion, he regards "dimensions" as six, dividing each of the three into two opposites, "up and down, before and behind, right and left," these terms being taken relatively. More pretentious was the procedure of Ptolemy who was an astronomer, but dealt also with the philosophy of mathematics. He was the first to offer a "proof" of the unprovable "parallel-postulate" of Euclid. In the same way he "disproved" the possibility of more than three dimensions, because, as Simplicius tells us, "it is possible to take only three lines that are mutually perpendicular, two by which the plane is defined and a third measuring depth."¹ The book containing Ptolemy's proof is now lost. Perhaps the first to approach the fourth dimension from the side of physics, was the Frenchman, Nicole Oresme,² of the fourteenth century. In a manuscript treatise, he sought a graphic representation of the Aristotelian forms, such as heat, velocity, sweetness, by laying down a line as a basis designated *longitudo*, and taking one of the forms to be represented by lines (straight or circular) perpendicular to

¹ *Simplicii in Aristotelis De Coelo Commentaria*, ed. Heiberg, Berlin, 1904, 7a, 33.

² P. Duhem, *Études sur Léonard de Vinci*, III^e série, Paris, 1913, p. 388; H. Wieleitner, *Isis*, vol. 7, 1925, pp. 487, 488.



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The Fourth Meeting of the Indiana Section

H. T. Davis (Secretary)

To cite this article: H. T. Davis (Secretary) (1927) The Fourth Meeting of the Indiana Section, The American Mathematical Monthly, 34:7, 342-345, DOI: [10.1080/00029890.1927.11986721](https://doi.org/10.1080/00029890.1927.11986721)

To link to this article: <https://doi.org/10.1080/00029890.1927.11986721>



Published online: 06 Mar 2018.



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C. H. YEATON, *Assistant Secretary*

THE FOURTH MEETING OF THE INDIANA SECTION

The fourth annual meeting of the Indiana Section of the Mathematical Association of America was held April 29-30, 1927 at DePauw University, Greencastle, Ind.

There were thirty present, including the following seventeen members of the Association:

W. C. Arnold, Gladys L. Banes, G. E. Carscallen, H. T. Davis, S. C. Davisson, J. E. Dotterer, W. E. Edington, P. D. Edwards, H. E. H. Greenleaf, F. H. Hodge, E. N. Johnson, Juna M. Lutz, T. E. Mason, C. K. Robbins, K. P. Williams, H. E. Wolfe, W. A. Zehring.

On Friday evening there was a banquet at which were present members of the Association and representatives from many of the science departments of the university. Professor W. M. Blanchard of the department of chemistry acted as toastmaster. At eight o'clock a public lecture, under the auspices of the Naperian Club and the Physics Seminar of DePauw University, was given by Professor Jakob Kunz, Professor of physics, University of Illinois, on the subject, "A popular review of the trend of modern physical science." The introduction was made by Professor O. H. Smith of the physics department of DePauw University. Professor Kunz first presented a picture of physics as it existed near the beginning of the present century as a result of the fundamental work of Faraday, Maxwell, Helmholtz, Kelvin and others. A set of principles had been formulated which seemed to establish an almost perfect foundation for an exact science. There were certain unsatisfactory features in this formulation, however, as, for example, the concept of action at a distance, the idea of an ether which was metaphysical rather than physical, and the second law of thermodynamics which makes no provision in nature for the re-creation of energy. During the last thirty years, all of our ideas have been undergoing a change. The classical foundations of physics have been attacked by fundamental experiments. The theory of relativity has replaced Newton's absolute space and time by a relative space and time. The Bohr theory of the atom has replaced the concept of a continuous flow of energy by a discontinuous flow of

energy and left the concept of the ether in a precarious state. In an attempt to reconcile theory with experiment, physicists have been led to replace the mechanical models of the last century by mathematical formulas. To show the extent to which this has been done the speaker cited the recent matrix quantum theory where infinite matrices have replaced physical intuition based upon mechanical analogies.

The meeting on Saturday was presided over by Professor E. N. Johnson of Butler College, chairman of the section. There was a short business meeting at which the following officers were elected: Chairman, Professor J. E. DOTTERER, Manchester College; Vice-chairman, Professor E. D. GRANT, Earlham College; Secretary-treasurer, Professor H. T. DAVIS, Indiana University.

A chairman's address was made by Professor Johnson on the subject, "A plea for the history of mathematics." Professor Johnson pointed out that no subject loses so much as mathematics when it is separated from its history. Numerous historical allusions were made to show how teaching can be aided by a knowledge of the struggles that underlie the growth of mathematical ideas. The address concluded with recommendations that the state board of education be petitioned to reduce its requirements in education and to increase its requirements in mathematics for mathematics teachers, this increase to include the history of mathematics as a required subject. Upon motion a committee was appointed to act on this suggestion and appropriate recommendations were adopted by the section.

The following papers were presented:

1. "A study of the reliability of certain types of mathematical tests," by Professor W. E. EDINGTON, Purdue University.
2. "A study in correlation of college grades, intelligence test grades, and personality ratings" by Mr. J. H. SHOCK, Purdue University. (Introduced by Professor F. H. Hodge).
3. "Function-theoretic determination of the area of a triangle" by Professor K. P. WILLIAMS, Indiana University.
4. "Laplace's calculus of generatrix functions" by Miss IRENE PRICE, Indiana University. (Introduced by Professor Davis).
5. "Some elementary properties of tensors" by Professor P. D. EDWARDS, Ball Normal School.
6. "A survey of methods for the inversion of integrals of Volterra type" by Professor H. T. DAVIS, Indiana University.
7. "Note on the validity of the formula for the standard deviation of a sum" by Professor W. E. EDINGTON, Purdue University.

Abstracts of the papers follow, the numbers corresponding to the numbers in the list of titles.

1. The reliability of a series of tests given to classes in freshman and sophomore college mathematics has been investigated by means of the correlation and Brown-Spearman formulas. The tests are of the essay type, the recall and the recognition types, and combinations of these types; they were given in fifty-minute and three-hour time periods. As is to be expected, the tests in formal differentiation and integration show moderately high reliability, whereas tests involving essay problems show a wide variation in reliability. The results of this study also suggest a method of testing the reliability of the teaching of the various mathematical topics by the instructor.

2. In this paper Mr. Shock computed the coefficient of correlation between college grades and intelligence grades, between college grades and personality estimates, and between intelligence grades and personality estimates, for one hundred Purdue seniors chosen at random. He found the correlation between college grades and the personality estimates to be the highest and the correlation between the intelligence grades and the personality estimates to be the lowest.

3. Professor Williams's paper appears in this number of the *MONTHLY*.

4. Laplace published in 1779 the method of generatrix functions which he made the foundation of his theory of probability. The principles of the method in their simplest form consist in treating the successive values of any function as the coefficients in the expansion of another function with reference to a second variable. The latter is called the generatrix function of the former. A direct and inverse calculus is thus created. Miss Price showed how this calculus may be used in the theory of interpolation, in the transformation of series, and in the expansion of functions and their differences into series. By means of the calculus of Laplace, the approximate value of an expression containing a great many terms may be found. Application was made to the evaluation of integrals found in the theory of probability.

5. The paper of Professor Edwards dealt with the definitions of contravariant tensors as extensions of the two types of vectors arising from the differentiation of the differentials dx_μ and the gradient of an invariant. The elementary properties of these tensors were considered with the laws of operation and the significance of covariant differentiation.

6. Professor Davis made a survey of the methods used to solve the Volterra integral equation of the first kind. The first part of the paper considered the case of the general kernel $K(x, y)$ and showed, in particular, the existence of singularities analogous to the regular and irregular singular points of linear differential equations. The second part of the paper dealt with a number of special methods that have been devised for solving the equation with a kernel of the form $K(x-y)$.

7. In a series of m sets of n items or measurements, it is well known that $\sigma_A = \sigma/\sqrt{n}$ and $\sigma_s = \sqrt{(\sigma_1^2 + \sigma_2^2 + \dots + \sigma_m^2)}$, where σ_A is the standard deviation of the average, σ the standard deviation of the mn items, σ_s the standard deviation of the sum, and σ_i ($i = 1, 2, \dots, m$), the standard deviation of the m sets. These formulas depend for their validity on the assumption that n is sufficiently large so that the sums of the product terms approach zero. In this paper Professor Edington determined the relation $\sigma_s^2 = m(1 - n^{-1})\sigma^2 = m(n-1)\sigma_A^2$, which affords a check on the validity of the use of the formulas for σ_s and σ_A when n is not large.

At the conclusion of the meeting, a vote of appreciation was extended to the department of mathematics, the Naperian Club, and the Physics Seminar of DePauw University. The time and place of the next meeting was left in the hands of the executive committee.

H. T. DAVIS, *Secretary*

THE MAY MEETING OF MARYLAND-VIRGINIA- DISTRICT OF COLUMBIA SECTION

The twenty-first meeting of the Maryland-Virginia-District of Columbia Section of the Mathematical Association was held on Saturday, May 7, 1927, at the University of Maryland, College Park, Maryland, the morning session opening at 11 A.M. and the afternoon session at 2:30 P.M. Those attending the meeting were guests of the University of Maryland at luncheon between the sessions, and also were guests at various athletic events before and after the sessions. Chairman J. A. Bullard presided at both sessions.

There were 53 present including the following 38 members of the Association: O. S. Adams, R. N. Ashmun, H. G. Avers, L. M. Blumenthal, C. C. Bramble, J. A. Bullard, P. Capron, A. Cohen, G. R. Clements, J. A. Duerksen, P. J. Federico, G. L. Fentress, M. Goldberg, H. Gwinner, W. M. Hamilton, G. W. Hansen, P. E. Hemke, H. P. Kaufman, G. H. Keulegan, W. D. Lambert, A. E. Landry, F. Morley, F. D. Murnaghan, J. R. Musselman, J. W. Peters, E. C. Phillips, O. J. Ramler, C. H. Rawlins, Jr., J. N. Rice, A. W. Richeson, R. E. Root, J. H. Schad, J. T. Spann, T. H. Taliaferro, A. A. Tomeldon, J. Tyler, P. Wernicke, E. W. Woolard.

The following program was presented:

1. "The problem of three vortices" by Prof. F. MORLEY, Johns Hopkins University.
2. "Euclidean invariants of the plane cubic" by P. J. FEDERICO and P. R. NEFF, U. S. Patent Office.
3. "Lagrange resolvents in Euclidean geometry" by L. M. BLUMENTHAL, Johns Hopkins University.



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The Fifth Meeting of the Indiana Section

H. T. Davis (Secretary)

To cite this article: H. T. Davis (Secretary) (1928) The Fifth Meeting of the Indiana Section, *The American Mathematical Monthly*, 35:7, 334-336, DOI: [10.1080/00029890.1928.11986847](https://doi.org/10.1080/00029890.1928.11986847)

To link to this article: <https://doi.org/10.1080/00029890.1928.11986847>



Published online: 06 Mar 2018.



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vidual life has profited by basic training in appreciation of beauty and by a realization of the exactness and order of the Universe.

PHILIP FITCH, *Secretary*

THE FIFTH MEETING OF THE INDIANA SECTION

The fifth meeting of the Indiana Section of the Mathematical Association of America was held May 11, 12, 1928 at Butler University, Indianapolis, Indiana.

There were sixty-one present at the meeting including the following thirty-one members of the Association: R. J. Aley, W. C. Arnold, Gladys L. Banes, Stanley Bolks, G. E. Carscallen, P. T. Copp, H. T. Davis, S. C. Davisson, J. E. Dotterer, W. E. Edington, P. D. Edwards, E. D. Grant, H. E. H. Greenleaf, Laurence Hadley, Cora B. Hennel, F. H. Hodge, E. N. Johnson, Kathryn M. Kennedy, Florence Long, Juna M. Lutz, T. E. Mason, H. R. Mathias, R. E. Peterson, C. K. Robbins, D. A. Rothrock, J. R. K. Stauffer, C. E. Stout, K. P. Williams, H. E. Wolfe, W. A. Zehring, and H. A. Zinszer.

On Friday evening at 6:30 a banquet was held at the Claypool Hotel which was attended by members of the Association and their guests. President Aley of Butler University presided.

At eight o'clock a public lecture under the auspices of Butler University was given by President D. W. MOOREHOUSE of Drake University, Des Moines, Iowa, on the subject: "The Milky Way." President Moorehouse, by means of lantern slides, traced the ever interesting history of man's expanding knowledge of the universe. The speaker called special attention to the perplexing problem presented by the presence of black patches in the midst of brilliant star clouds and showed how the evidence points to the existence of great dark nebulous masses in the milky way.

At the session on Saturday morning on the Butler campus, presided over by Professor J. E. Dotterer, Manchester college, chairman, the following officers were elected: Professor H. E. H. GREENLEAF, De Pauw University, chairman; Professor H. A. ZINSZER, Hanover College, vice-chairman; Professor H. T. DAVIS, Indiana University, secretary-treasurer.

A chairman's address was made by Professor J. E. DOTTERER on the subject: "The Mathematician as a Salesman." Professor Dotterer pointed out the duty incumbent upon the teacher, in addition to his actual instruction, of showing the fundamental connection between mathematics and actual living. He urged the need of exhibiting mathematics not only as a tool used in solving and explaining the universe in which we live, but also as a discipline, a cultural subject and an art.

Professor R. H. COON of the Latin Department of Indiana University fur-

nished a pleasing variation to the program with a translation of Tycho Brahe's: "The Science of Mathematics and Astronomy," a public lecture given in the year 1574. The translation was prefaced by a summary of the life and achievements of the famous astronomer.

The morning program concluded with a pageant: "Pictures from the Pages of Mathematical History," which was presented by the department of mathematics of Butler University under the direction of Miss Gladys Banes, Professor E. N. Johnson, and Miss Juna Lutz. The words were written by Miss Lutz. The pageant comprised a survey of mathematical history from the time of Fuh-hi, 2852 B.C. to Henri Poincaré, and was especially noteworthy in the accuracy with which the various mathematicians had been reconstructed from their pictures.

The afternoon program consisted of the following papers:

1. "A generalization of the construction of the ellipse," by Professor F. H. HODGE, Purdue University.
2. "Some remarks concerning the exponential function," by Professor K. P. WILLIAMS, Indiana University.
3. "The teaching of analytic geometry," by Professor T. E. MASON, Purdue University.
4. "Function theoretic determination of the law of sines and the law of cosines for any plane triangle," by Mr. L. R. KELLAM, Indiana University. (Introduced by Professor Williams.)
5. "Some new formulas in curve fitting by least squares," by Mr. V. V. LATSHAW, Indiana University. (Introduced by Professor S. C. Davisson.)
6. "The place of statistics in the mathematics curriculum," by Professor H. T. DAVIS, Indiana University.
7. "On Fresnel's theory of diffraction," by Professor H. A. ZINSZER, Hanover college.

Abstracts of the papers follow, the numbers corresponding to the numbers in the list of titles:

1. This paper generalized the method of constructing an ellipse by means of two concentric circles and the eccentric angle. One circle is taken with center at the origin and the second with center at $(h, 0)$. The locus of the point whose x and y intercepts are determined by the respective intersections of a straight line drawn from the origin through the two circles is found to be a cubic, some of whose properties were studied.
2. It is customary in books on the calculus to give only an incomplete discussion of $\lim_{n \rightarrow \infty} (1 + zn^{-1})^n$, leaving the problem to the theory of functions. On the other hand, books on function theory are likely to regard the problem as disposed of in the calculus. Professor Williams spoke on some of the details

necessary for a systematic treatment. Attention was also directed to certain generalizations that throw some light upon the exponential function.

3. Analytic geometry, according to Professor Mason, should be taught in such a manner as to give three things to the student: (1) A certain facility in drawing approximate graphs of functions; (2) ability to put into the form of an equation a description of a locus; (3) ability to interpret results. The learning of specific facts about particular curves is only incidental.

4. This paper showed how the law of sines and the law of cosines for any plane triangle may be determined from function theoretic properties. A simple list of these fundamental properties with specific application to one or two special cases for the determination of constants was used in obtaining the desired expressions.

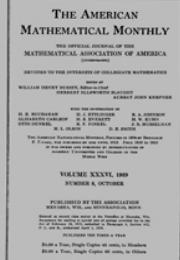
5. Karl Pearson has indicated the desirability of computing the coefficients of polynomials fitted to data by the method of least squares where the values of the abscissa are assumed to be the integers from 1 to p . This paper gave these coefficients for the straight line, the parabola and the cubic. Coefficients were also computed for the quartic in the case where the number of points is odd.

6. It was pointed out in this paper that there seems to be a new movement toward the emphasis of statistics as a mathematical course. The theory of probability, which deals primarily with *a priori* probabilities, is admittedly a mathematical subject. Statistics which deals, on the other hand, with *a posteriori* probabilities obtained from empirical data, must not be approached with an aversion inherited from mathematical training in more subjective theories. The progress of this work in the mathematics department at Indiana University was explained.

7. The speaker gave a resumé of the Fresnel theory of diffraction with special reference to diffraction through a narrow slit bounded by parallel edges. The application of Cornu's spiral was explained.

At the conclusion of the meeting a vote of appreciation was extended to the department of mathematics of Butler University. The time and place of the next meeting were left in the hands of the executive committee.

H. T. DAVIS, *Secretary*



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The Sixth Annual Meeting of The Indiana Section

H. T. Davis (Secretary)

To cite this article: H. T. Davis (Secretary) (1929) The Sixth Annual Meeting of The Indiana Section, *The American Mathematical Monthly*, 36:8, 414-418, DOI: [10.1080/00029890.1929.11986990](https://doi.org/10.1080/00029890.1929.11986990)

To link to this article: <https://doi.org/10.1080/00029890.1929.11986990>



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deformation are equal. Since the quantity on the right hand side should be a minimum, the problem is to find the equation of the elastic curve which will make it so. An approximate solution may be found by setting up a series of the form

$$y = a_1 f(x_1) + a_2 f(x_2) + a_3 f(x_3) + \dots,$$

in which each term satisfies the boundary condition of the problem and where a_1, a_2, a_3 , etc. are parameters to be determined so that the curve produces a minimum value for P . This value of P is a critical value and is on the boundary between stable and unstable equilibrium.

6. In this paper Miss Carlson pointed out some of the differences in methods used in teaching classes of about one hundred students as compared with methods used in teaching small classes. Also, she gave figures showing that the grade of work done by the students in the large classes compared favorably with the grade of work done by the students in the small classes.

7. Mr. Jackson spoke briefly about the organization and purposes of a committee on college entrance requirements in geometry, with regard to which a more detailed announcement appeared in the August-September number of this Monthly.

A. L. UNDERHILL, *Secretary*

THE SIXTH ANNUAL MEETING OF THE INDIANA SECTION

The sixth annual meeting of the Indiana Section of the Mathematical Association of America was held May 3-4, 1929 at Culver Military Academy, Culver, Indiana.

There were sixty present at the meeting including the following twenty-nine members of the Association: W. C. Arnold, Gladys Banes, Stanley Bolks, H. T. Davis, S. C. Davisson, C. S. Doan, J. E. Dotterer, P. D. Edwards, E. D. Grant, H. E. H. Greenleaf, G. E. Happell, C. T. Hazard, F. H. Hodge, H. K. Hughes, Juna M. Lutz, William Marshall, T. E. Mason, H. R. Mathias, G. T. Miller, J. A. Reising, C. K. Robbins, L. S. Shively, J. R. K. Stauffer, R. B. Stone, R. O. Virts, C. J. Waits, K. P. Williams, W. A. Zehring, H. A. Zinszer.

On Friday afternoon at 5:30 a reception was given to the visiting members and their guests. At 6:30 a complimentary banquet which was held in the mess hall was attended by approximately ninety guests of the academy. General L. R. Gignilliat, superintendent of the academy, presided at the banquet and made a brief address of welcome. Entertainment was furnished by Major Norman Imrie, head of the public speaking department of the academy, who regaled the guests with stories appropriate to the occasion. Music was furnished during the banquet by the cadet band.

At eight o'clock a public lecture under the auspices of the academy was given in the gymnasium by Professor Warren Weaver of the University of Wisconsin

on the subject, "Science and Imagination." Professor Weaver presented the new view of mathematical and physical science which is emerging from modern speculations. Ancient mathematics, according to the speaker, made use of defined elements and self-evident axioms. Modern mathematics makes use of undefined elements and assumed postulates. The theorems of modern mathematics are thus creations, not discoveries. Since mathematics is now a product of the creative imagination, it deserves consideration as an art. A somewhat similar change has come about in the logical structure of physical theories. The older model theories of physics explaining by analogy are comparable to the older mathematics; while the modern more abstract physical theories are more closely related with modern postulational mathematics. In the development of physical theories, therefore, the imagination now plays a more significant rôle than formerly and the theories have become more artistic in structure.

At 8:30 Saturday morning, a military review was held in honor of the visitors and this was followed by a tour of the academy buildings.

At the session at 10:00 a.m. in the Memorial Building of the Academy presided over by Professor H. E. H. Greenleaf, De Pauw University, chairman, the following officers were elected: Professor H. A. Zinszer, Hanover College, Chairman; Professor E. D. Grant, Earlham College, Vice-chairman; Professor H. T. Davis, Indiana University, Secretary-treasurer.

A chairman's address was made by Professor Greenleaf on the subject, "Mathematics in the Fundamentals of Music." Professor Greenleaf, considering the musical scale and the principal intervals of music as fundamental, discussed the changes in the scale from earliest times to the present. The speaker pointed out the mathematical basis of the Pythagorean, the diatonic, the mean-tone temperament, and the equal temperament scales and intervals and made a comparison of the four in regard to tonality.

The remainder of the program consisted of the following papers:

1. "The sectioning of freshman engineering students in mathematics," by Professor William Marshall, Purdue University.

2. Extracts from a discourse of J. F. Hennert (Utrecht, 1765): "On the necessity of including the study of mathematics in a good education," by Professor T. E. Mason, Purdue University.

3. "Invariance under the symmetric group of order three of a functional equation due to Abel," by Professor P. D. Edwards, Ball State Teacher's College.

4. "A solution of the biquadratic equation," by Professor E. D. Grant, Earlham College.

5. "A certain general type of contact transformation in three dimensions," by Professor C. K. Robbins, Purdue University.

6. "Three methods for finding the shortest distance between two skew lines" by Margaret L. Darragh, Hanover College (Introduced by Professor Zinszer).

7. "Transformations by reciprocal rays," by Mr. James Avas Cooley, Indiana University (Introduced by Professor H. E. Wolfe).

8. "Some properties of the circles that can be connected with the complete quadrilateral," by Mr. Maurice M. Lemme, De Pauw University (Introduced by Professor Greenleaf).

9. "Present status of the theory of the Volterra integral equation of the second kind," by Professor H. T. Davis, Indiana University.

10. "Notes on quantum mechanics," by Professor H. A. Zinszer, Hanover College.

Abstracts of the papers follow:

1. In the fall of 1928 the mathematics department of Purdue University divided the incoming freshmen in engineering mathematics into three groups: a sub-collegiate group, a normal group, and an advanced or honor group. Professor Marshall set forth in some detail the reasons for this sectioning, how it was done, how the various groups were handled, and the results of the experiment in so far as they are apparent at the present time.

2. Professor Mason's paper consisted of a translation of the inaugural address of J. F. Hennert at Utrecht on a subject of perennial interest to mathematicians. The striking feature of this discourse lies in the fact that the criticisms of students made by this professor in 1765 sound very modern. Apparently students have not changed much in the last century and a half. There are some reasons advanced to the people of the commercial town of Utrecht for the study of mathematics and physics which we should put today under the heading of reasons for the study of engineering.

3. In order that $F(x, y)F(y, z)F(z, x)$ be identical with $F(y, x)F(z, y)F(x, z)$ it is obviously sufficient that $F(x, y)$ be composed of factors which are (1) functions of x only, or (2) functions of y only, or (3) symmetric functions of x and y . That the condition is also necessary is not evident. Proof is given that if F is an algebraic function which is rational, or if irrational, one that belongs to a realm in which the unique factorization law holds, then the conditions named are necessary. Extension is made to the invariance of the function $F(x_1, x_2)F(x_2, x_3) \cdots F(x_n, x_1)$ under the symmetric group of order n .

4. The biquadratic equation is first reduced to the form lacking the term in x^3 . The roots are assumed to be $a \pm \sqrt{b}$, $-a \pm \sqrt{c}$. If we express the relation between the roots and the coefficients, there are three equations to solve for a , b , and c . The elimination of b and c leads to an equation of the sixth degree in a , containing the terms a^2 , a^4 , and a^6 . This equation may be solved by Cardan's method in any numerical case; b and c may then be obtained, and the four roots written out.

5. If the transformation $x' = f_1(x, y, z, p, q)$, $y' = f_2(x, y, z, p, q)$, $z' = f_3(x, y, z, p, q)$, $p' = f_4(x, y, z, p, q)$, $q' = f_5(x, y, z, p, q)$ transforms a union of plane elements into a union of plane elements, it is a contact transformation. The analytical condition is that the vanishing of $p'dx' + p'dy' - dz'$ is a consequence of the vanishing of $pdx + qdy - dz$. This leads to a set of four partial differential equations, the integration of which can be determined (theoretically) according to the general theory of such equations. The actual application of this condition

seems to lead to insurmountable difficulties, but certain special cases are of interest. In particular if f_4 and f_5 are functions of p and q only, that is if the orientation of the plane in the transformed element depends only on the orientation of the plane in the original element, the system of partial differential equations can be completely solved. If $f_4 = p$ and $f_5 = q$, and the arbitrary function introduced by integration assumes a certain value, the transformation becomes the well known dilation.

6. The following methods were discussed: I. Through each of the lines any plane is passed perpendicularly. At some position of these planes their line of intersection will intersect each of the skew lines. The distance between these points is the shortest distance between the two lines. II. A plane is constructed perpendicular to one of the lines and through each line a plane is passed perpendicular to it. By expressing the equations for these two planes in their normal form and adding the right members the distance is obtained. III. The last method finds the distance directly by the minimizing process.

7. Laguerre in *Nouvelles Annales*, 3rd series, volume 1, defined the transformation by reciprocal rays and gave some of its properties. Mr. Cooley introduced a new constant for the modulus of the transformation, defining it as a cross ratio. In terms of the constant, he developed relations between the angle which reciprocal rays make with each other and the axis of transformation. He also gave additional properties and applications of the transformation especially with regard to circles and their tangents.

8. This paper proved by methods of Euclidean geometry alone the following theorem given by Jakob Steiner in the *Annales de Gergonne*, vol. 18, p. 16: In each of the four triangles formed by the sides of a complete quadrilateral there is one circle inscribed and three circles escribed, making in all sixteen circles. The centers of these sixteen circles arrange themselves in groups such that each of the four circles of one group cuts orthogonally all the circles of the other group. The lines of centers of the two groups of circles are perpendicular to each other. The lines of centers of the two groups of circles intersect at the point of intersection of the circles circumscribed to the four triangles forming the quadrilateral. Various consequences of the theorem were also exhibited by the speaker.

9. The methods used to solve the Volterra integral equation, not only for the case of continuous kernels, but for various types of discontinuities, were discussed. Numerous properties of the equation of the closed cycle, namely the case of the kernel of the form $K(x-t)$, were exhibited.

10. Assuming a closed system consisting of a nucleus and an electron the former being a point charge located at the origin of coordinates, the principle of the conservation of energy expressed in Newtonian notation was imposed. Applying the principle of Maupertuis (least action) and assuming the resulting equation to describe a family of wave-fronts travelling with a speed $E/\sqrt{[2m(E-V)]}$, where E is the total energy and V the potential energy function, a particular form of de Broglie's wave equation finally resulted.

At the afternoon session a resolution was adopted by the members of the section expressing their appreciation of the welcome that had been given them by the academy and of the efforts of General Gignilliat and of Major G. H. Crandall, Captain L. R. Kellam and other members of the department of mathematics who had contributed to the success of the meeting.

H. T. DAVIS, *Secretary*

A MODIFICATION OF A PROOF BY STEINER

By OTTO DUNKEL, Washington University

INTRODUCTION. An elegant and elementary proof was given by Steiner of the theorem that the equilateral triangle has the greatest area of all triangles having the same perimeter.¹ This proof is interesting in that no use is made of either parallels or metrical expressions for the area; it applies therefore whether the sum of the angles of a triangle is supposed to be less than, equal to, or more than 180° , and Steiner showed that his proof applied to spherical triangles without essential change. His proof consists of two parts of which the first part is essentially the proof under Theorem I below, while the second part has been altered to the form of proof under Theorem II. This modified form of proof is applicable to other similar geometrical theorems, and two such theorems are proved in this way without the use of parallels or metrical expressions for the area. The following proofs are worded for spherical triangles since in a few places restrictions are required peculiar to this form of geometry. For the cases where the sum of the angles of the triangle is less than or equal to 180° the proofs are essentially the same but simpler. In conclusion two theorems are given which result from the consideration of a metrical expression for the area. In the discussions below when one side of a triangle is designated as a base the term side will be considered to apply only to the two remaining sides.

THEOREM I. *Two triangles which have equal perimeters and bases of equal lengths have unequal areas if they are neither congruent nor symmetric. The triangle having the smaller area has the smallest base angle, the greatest base angle, the shortest side and the longest side.*

PROOF: Let ABC and $A'B'C'$ be two triangles which are neither congruent nor symmetric, but are such that $AB = A'B'$, $AC + BC = A'C' + B'C'$, $A \leq B$, $A' \leq B'$, where A denotes the angle BAC etc. The equality signs in the last relation are assumed to hold for only one triangle, for otherwise the two triangles would be congruent. Let the bases be made to coincide so that A' falls at A and B' at B . If then C and C' fall on opposite sides of the common base, we shall replace one triangle by its symmetric triangle and we shall suppose that the lettering of the vertices of the new triangle is the same as that for the old.

¹ Steiner, *Sur le maximum et le minimum des figures dans le plan, sur la sphère et dans l'espace en général*, Crelle's Journal, vol. 24 (1842), pp. 96-99.



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The Seventh Annual Meeting of the Indiana Section

V. V. Latshaw (Acting Secretary)

To cite this article: V. V. Latshaw (Acting Secretary) (1930) The Seventh Annual Meeting of the Indiana Section, *The American Mathematical Monthly*, 37:8, 395-398, DOI: [10.1080/00029890.1930.11987101](https://doi.org/10.1080/00029890.1930.11987101)

To link to this article: <https://doi.org/10.1080/00029890.1930.11987101>



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which a number belongs, indices, primitive roots, etc.) can in a very simple and satisfactory manner be demonstrated by means of a square table which for a given fixed prime modulus gives both the residues of a^λ for λ fixed, a variable; and for a fixed, λ variable.

Some apparently new results will be presented on another occasion.

10. Professor Jackson's paper discussed applications of the geometrical interpretation of correlation coefficients less simple than those which are treated in papers published in recent volumes of the Monthly. In particular, it gave a geometrical derivation of the regression coefficients for a problem involving three statistical variables.

The members and friends of the association were guests of the University of Denver at a banquet on the evening of April 11. President Gorrell acted as toastmaster. The address of welcome was given by Chancellor Frederick Hunter of the University of Denver. The response was given by Professor A. J. Kempner of the University of Colorado.

Following this a very interesting and instructive address was given by the guest of honor, Professor Dunham Jackson, on "The significance of elementary mathematics in modern statistics."

A. J. LEWIS, *Secretary*

THE SEVENTH ANNUAL MEETING OF THE INDIANA SECTION

The seventh annual meeting of the Indiana section of the Mathematical Association of America was held on May 2-3, 1930 at Earlham College, Richmond, Indiana.

There were forty-five present at the meeting including the following twenty-three members of the Association: W. C. Arnold, R. W. Babcock, Gladys L. Banes, G. E. Carscallen, P. T. Copp, C. S. Doan, J. E. Dotterer, W. E. Edington, P. D. Edwards, E. D. Grant, G. H. Graves, H. E. H. Greenleaf, C. T. Hazard, D. F. Heath, Cora B. Hennel, Florence Long, Juna M. Lutz, T. E. Mason, J. A. Reising, C. K. Robbins, L. S. Shively, K. P. Williams, W. A. Zehring.

On Friday at 5:30 P.M. a reception was given to the visiting members and their guests. At 6:30 P.M. a complimentary banquet which was held in the dining room of the college was attended by sixty guests of the college. Professor E. D. Grant presided at the banquet and introduced President Denny of Earlham College, who made a brief address of welcome. Music was provided during the banquet by a trio of students of the college.

At eight o'clock a short pipe organ recital was presented in Stoddard Auditorium. The public lecture of the evening, under the auspices of Earlham College, was given by Professor Louis C. Karpinski of the University of Michigan

on the subject, "Mathematics and the Eternal Verities." Professor Karpinski pointed out that work and intensive intellectual application are the foundations of success not only in mathematics but in all the arts and sciences upon which the progress of civilization rests. In mathematics the student is inevitably confronted with these realities more than in any other subject of the school curriculum. Particularly for students who are likely ever to do creative work mathematics furnishes stimulus and inspiration. Even also for the great mass of students in our secondary schools mathematics is one of the few studies in which the fact of intellectual work or lack of work is made evident in every recitation. When this fact is combined with the fact that mathematics is the indispensable foundation for the study of engineering, economics, physics, and many other sciences, it becomes evident that mathematics must continue to hold a prominent place in our secondary school program.

At ten o'clock Saturday morning in Carpenter Hall the following officers were elected for the coming year: Chairman, P. D. Edwards, Ball State Teachers College; Vice-Chairman, G. E. Carscallen, Wabash College; Secretary-Treasurer, H. T. Davis, Indiana University.

A chairman's address in absentia by Professor Zinszer on "Sub-atomic Versus Interstellar Space," was read by Professor Grant. The first part of the paper consisted of a rapid review of the discoveries in the field of modern physics and their mathematical agencies. This included a brief description of Millikan's determination of the electronic radius, also Rutherford's determination of the approximate size of the nucleus of the gold atom. Following an exposition on the method of parallax and its application to astronomy, the paper took up a discussion of the galactic system and its dimensions.

The following seven papers were read:

1. "On non-composite plane curves of the form $C_6:8A^2B^2$," by Professor J. C. Polley, Wabash College, by invitation.
2. "Uses of vectors in geometry and trigonometry," by Professor R. W. Babcock, DePauw University.
3. "Number one and number naught," by Dr. A. F. Bentley, Paoli, Indiana, by invitation.
4. "Amount of training in mathematics required of high school teachers of mathematics in the various states," by Professor P. D. Edwards, Ball State Teachers College.
5. "Technique of instruction for large classes in mathematics," by Mr. C. E. Trueblood, Arsenal Technical Schools, Indianapolis, Indiana, by invitation.
6. "The predicted location of the 1930 center of population of the United States," by Professor L. S. Shively, Ball State Teachers College.
7. "The minimum essentials' place in mathematics courses," by Professor G. H. Graves, Purdue University.

Abstracts of these papers follow:

1. In this paper the author considers the web of sextic curves of the form $C_6:8A^2$, i.e., with eight double points. It is shown that: (1) on any non-composite

sextic C_6 of the web there are six points where a member of the pencil of cubics $C_3 - kC_3^1 = 0$ and C_6 have a common tangent and each point is a ninth double point on a non-composite web; (2) the locus of the ninth double point is a curve of order nine of the form $C_9:8A^3$.

2. Professor Babcock thinks that the concept of vector is within the grasp of the average pupil of geometry. Various problems involving intersections of lines of projections of lines may easily be solved by vector algebra. Several of the formulae of elementary trigonometry are easily derived by means of the scalar product. This work may be used for special projects for students who are possessed of intellectual curiosity.

3. Under Hilbertian technique, though not Hilbertian minimal presupposition, we may define a pure mathematics as any system of full consistency. Examining inductive numbers with the approach of Kronecker or Poincaré, rather than with the scaffoldings of Russell or of the Mengenlehre, we obtain a pure theory of number to which the distinctions of cardinal and ordinal are irrelevant. The cardinal is relegated to the "impure" or "foundation" regions of mathematics. Realistic and analytic (semantic) postulates for the investigation of Number One are constructed, and analysis is carried through by differentiation of operative zeros from realistic nulls, and by similar differentiation of infinities. A semantic number series and a semantic radix series are constructed. Under this construction proof is given that decimals are denumerable. The Cantorian proof of non-denumerability yields under analysis its realistic elements and fixations. Analysis of the ordinary form of proof that Null is a Zahl yields similar evidence of confusion between semantic symbol and realistic reference.

4. Practically all the states issue from two to a dozen different grades of high school certificates. The author discussed only the requirements for the certificates of highest grade. In most of the states a certificate of general validity for all subjects is granted. Consequently the teacher of high school mathematics may have studied no mathematics of college grade. In addition to a discussion of these requirements for the various states the author suggested some action on the part of college instructors of the state might improve the secondary teaching in Indiana.

5. During the past five or six years Mr. Trueblood has been experimenting with classes of a hundred students and finds that the results are satisfactory both from the standpoint of the teacher and the students. In this paper he outlined the method of conducting large classes and pointed out the special technique necessary.

6. Professor Shively predicted the location of the center of population of the United States basing his calculation upon estimates of population increase and of the distribution of population during the preceding decade. The results of the calculation, which was made as of January 1, 1930, are that the center has moved westward 13.2 miles and northward 2.8 miles with probable errors

of 1.25 and .84 miles respectively. This places it in N. Lat. $39^{\circ}13'$ and W. Long. $86^{\circ}58'$, a point a little to the southwest of Arney in Owen County, Indiana.

7. In this paper the author sketched a plan in use at Purdue University. The course is divided into a few heads and after the class periods allotted to each of these have been devoted to discussion, recitation, and illustrative examples as usual, a test is given which determines, with the class work, whether the student has "cleared his record" on that head. No grades are given during the course and only those who clear their record under all the heads by the end of the term receive credit for the course.

At the close of the meeting a resolution was adopted by the members expressing their appreciation to Earlham College and to the mathematics department for the splendid banquet and their efforts in making the meeting a success. Also the section expressed its appreciation to Professor Karpinski and Dr. Bentley.

V. V. LATSHAW, *Acting Secretary*

THE FOURTEENTH MEETING OF THE KENTUCKY SECTION

The fourteenth regular meeting of the Kentucky Section of the Mathematical Association of America was held at Transylvania College, Lexington, Kentucky, on Saturday, April 15, 1930. The Section was fortunate in having as its guest Professor W. D. Cairns, Secretary-Treasurer of the Association.

There were forty-three present, including the following twenty-one members of the Association: P. P. Boyd, W. D. Cairns, C. E. Caldwell, M. G. Carman, M. C. Dame, J. M. Davis, D. S. Dearman, A. R. Fehn, W. W. Garnett, Charles Hatfield, W. R. Hutcherson, C. G. Latimer, Elizabeth LeStourgeon, Mrs. A. R. Lyon, C. A. Maney, W. L. Moore, Smith Park, Sallie Pence, D. W. Pugsley, J. H. Simester, Guy Stevenson.

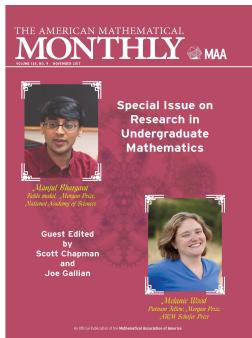
The chairman, Professor C. A. Maney, presided at both the morning and afternoon sessions. All present were guests of Transylvania College at luncheon.

The officers elected for the coming year were: Chairman, Professor J. M. Davis, University of Kentucky; Secretary, Professor A. R. Fehn, Centre College.

The program of the meeting was as follows:

Morning Session, 10:00 A.M.

1. "A certain identity in theta functions" by Mr. Smith Park, University of Kentucky and Eastern State Teachers' College.
2. "Trigonometric formulae by vector analysis" by Professor W. R. Hutcherson, Berea College.
3. "Mathematics—What's the use?" by Professor J. M. Davis, University of Kentucky.



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The Eighth Annual Meeting of the Indiana Section

H. T. Davis (Secretary)

To cite this article: H. T. Davis (Secretary) (1931) The Eighth Annual Meeting of the Indiana Section, *The American Mathematical Monthly*, 38:8P1, 429-433, DOI: [10.1080/00029890.1931.11987221](https://doi.org/10.1080/00029890.1931.11987221)

To link to this article: <https://doi.org/10.1080/00029890.1931.11987221>



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on the old type test and 5% higher on the new type test on the basis of a perfect score. In terms of the average score for the 1600 students the gain is $12\frac{1}{2}\%$. Students sectioned into two groups at an hour show a 4% gain on the old type test, but less than 1% on the new type test. The experiment affords strong evidence for the value of sectioning when three groups meet at an hour and some evidence for sectioning two at an hour. The method of sectioning has been adopted as a policy in the department at the University of Illinois for classes in analytics.

7. Dr. Wall shows that the summability of a power series $\sum c_i z^i = P(z)$ afforded by the Padé table is a species of the following kind of summability. Let

$$y_s = \sum_{i=0}^s c_i z^i + z^{s+1} \sum_{i=0}^{\infty} c_i^{(s)} z^i,$$

where

$$\sum_{i=0}^s \alpha_{i,p}^{(s)} c_i + \sum_{i=0}^p \alpha_{s+i+1,p}^{(s)} c_i^{(s)} = 0, p = 0, 1, 2, \dots.$$

Now, if, over a region R of the z -plane, $\lim_{s \rightarrow \infty} y_s = y$, then y is a generalized sum (over R) of $P(z)$. For a proper choice of the $\alpha_{i,p}$, y_s is a Padé approximant of $P(z)$, and is a rational fraction. This "Padé summability" is discussed from various angles, e.g. regularity, applicability, connection with other summabilities, etc. The writer's notion (Bulletin of the American Mathematical Society, vol. 36, p. 646) of a straight line of functional equivalents of $P(z)$ is discussed and amplified.

C. N. MILLS, *Secretary*

THE EIGHTH ANNUAL MEETING OF THE INDIANA SECTION

The eighth annual meeting of the Indiana Section of the Mathematical Association of America was held at Ball State Teachers College, Muncie, Indiana, on Friday and Saturday, May 1 and 2, 1931.

There were one hundred fifty present at the meeting, including the following twenty-five members of the Association: W. C. Arnold, E. R. Bowersox, G. E. Carscallen, P. T. Copp, H. T. Davis, W. E. Edington, P. D. Edwards, T. C. Fry, E. D. Grant, H. E. H. Greenleaf, F. H. Hodge, H. K. Hughes, Florence Long, Juna M. Lutz, H. R. Mathias, T. E. Mason, H. A. Meyer, T. W. Moore, Mary S. Paxton, J. A. Reising, C. K. Robbins, L. S. Shively, W. O. Shriner, R. O. Virts, K. P. Williams.

On Friday evening at 6:30 a banquet was held at Lucina Hall on the campus which was attended by 58 members and guests of the Association. Professor L. H. Whitcraft of the mathematics department of Ball State Teachers College presided. Following two musical selections, the keys of the College were turned over to the visitors in a felicitous address by President L. A. Pittenger. The welcome

was further emphasized in a short address by Dean Ralph Noyer who spoke of the great debt owed to mathematicians by the world as exemplified in the work of Clerk Maxwell and others who have connected pure mathematics with the world of our experience.

At eight o'clock a public lecture was given in Science Hall by Dr. Thornton C. Fry, of the Bell Telephone Laboratories of New York City, who spoke on the subject, "Mathematics comes into its own." Dr. Fry began by painting a picture of the history of mathematical physics from its origin in the atomic theory of Democritus. He showed in epitome the long warfare between proponents of the corpuscular theory of nature and advocates of the theory of continuity in the underlying stratum of things. Bringing the story to the modern era he showed the great perplexity of physics today in its attempt to rationalize the experiments of the quantum theory. The speaker affirmed that we have had three major syntheses of physical experience: (1) Newton's theory of universal gravitation; (2) Maxwell's theory of electricity and magnetism; (3) Einstein's geometrization of nature. He predicted that the fourth synthesis will appear in the mysteries of the quantum theory and stated that great progress toward this end appears in the work of Schrödinger, Born, de Broglie, Heisenberg, Dirac and other mathematical physicists. He emphasized the fact that the first three syntheses were of a definitely mathematical character and that there were indications that the fourth would be of the same nature. The speaker asserted that mathematics only fully comes into its own in so far as it comes in intimate contact with more objective sciences such as physics, quoting in this connection from the preface to the second edition of Newton's *Principia*: "Those who fetch from hypotheses the foundations on which they build their speculations, may form, indeed, an ingenious romance; but a romance it will still be." He concluded with a plea for more attention in America to this border-line work which has heretofore been left almost exclusively to Europeans.

The session on Saturday morning in Science Hall was presided over by Professor P. D. Edwards, Ball Teachers' College, chairman. The following officers were elected: Chairman, Professor G. E. Carscallen, Wabash College; Vice-chairman, Professor T. E. Mason, Purdue University; Secretary-Treasurer, Professor H. T. Davis, Indiana University.

A chairman's address was made by Professor Edwards on "Reorganization of secondary mathematics." Professor Edwards discussed the advantages that would result from a reorganization of secondary mathematics on the plan recommended by the National Committee. It was pointed out that at present 405 of the 841 high schools in Indiana are organized on the 6-6 plan. Mathematics is a required subject through grade nine, but is an elective in grades 10-12. Comparison was made with the mathematics curriculum in Europe where algebra and intuitive geometry are begun as early as grade six. The advantages of the longer period of instruction in algebra were emphasized. The reorganization results in advantages to the student who does not continue his mathematical studies beyond grade nine as well as to the student who continues his study in the senior

high school and college. Emphasis was placed on the rapid increase in recent years of the need for knowledge of statistics, graphs, equations, compound interest and annuities. For the person continuing in mathematics it was pointed out that the three-year interval for the acquisition of the essentials of algebra would result in better fixation of habits of thinking in terms of algebraic symbols. Suggestions were made concerning possible reorganization of material in the senior high school. It was shown that in the decade since the National Committee made its report there has been practically no change in the teaching of secondary mathematics in Indiana. A plea was made that the members of the Mathematical Association take the initiative in bringing about such a reorganization as will best serve the interests of the state.

Mr. Russell Sullivan of Indianapolis presented by invitation an illustrated lecture on "The evolution of the stars." Mr. Sullivan devoted special attention to modern interpretations of the various kinds of nebulas. He sketched the step-ladder evolutionary theory which puts the red giant stars at one foot of the ladder (youth), the blue stars at the top, and the red dwarfs at the other foot (old age). He concluded with an exposition of the interpretation of the high recessive velocities of the spiral nebulas as evidence of the curvature of space-time.

The remainder of the program consisted of the following papers, the third one being read by title:

1. "The early history of Kepler's equation" by Professor K. P. Williams, Indiana University.
2. "Class size, past, present and future" by Mr. C. E. Trueblood, Arsenal Technical Schools, Indianapolis, by invitation.
3. "Synthetic projective geometry as an aid to high school teachers" by Professor W. C. Arnold, De Pauw University.
4. "Some applications of the calculus of residues to the theory of functions" by Professor H. K. Hughes, Purdue University.
5. "Notes on generatrix functions with an application" by Mr. Fred Robertson, Iowa State College, Ames, Iowa, by invitation.
6. "A problem in grade distribution" by Professor C. K. Robbins, Purdue University.
7. "Some recent results in the theory of elimination" by Professor T. W. Moore, Indiana University.

Abstracts of the papers follow, the numbers corresponding to the numbers in the list of titles:

1. This paper described Kepler's formulation of his famous problem and his treatment of it as given in the *Astronomia Nova* (1609), the *Epitome Astronomiae Copernicae* (1618), and the *Tabulae Rudolphinae* (1627). The tabular solution in the latter disposed of all the actual astronomical necessities of the time, but the comments in the *Astronomia Nova*, which despaired of the possibility of a solution, and the method of approximations in the *Epitome*, usually overlooked by commentators, showed Kepler's desire for an adequate treatment. The later his-

tory of the problem was traced to the time of Lagrange. It was pointed out how the problem could be made an instructive one in a course on the history of mathematics that drew on actual sources.

2. In 1924-25 the speaker established large classes with the idea of developing a suitable technique for handling large numbers in mathematics, in view of the conclusion reached from educational studies made since 1896 that size of class has little influence upon student achievement. His classes ranged in size from 80 to 120. The technique which he established in his first four or five classes has been used with minor improvements ever since. He is now teaching his seventeenth class of 100 in mathematics. His conclusions are: (1) In spite of the success of large class technique there will always be a place for the small class; (2) one teacher will be able to teach three classes of 100 students as efficiently as six classes of 25; (3) one serious fault of present teaching technique is that highly trained teachers are required to perform too many minor details. This can be eliminated by improved methods.

3. In this paper a plea is made for the wider study of synthetic projective geometry among high school teachers. It is pointed out that this mathematical discipline is self-contained and hence is admirably adapted to the needs of one who might wish to extend his knowledge without class-room instruction. Synthetic projective geometry is also more closely connected with the geometry in which the high school teacher is giving instruction than with either analytics or calculus, and its range of beautiful theorems has an esthetic appeal that is not exceeded by other mathematical subjects of similar difficulty.

4. In this paper Professor Hughes considered functions defined by certain types of infinite series, the series themselves being regarded as given. The particular problem was to extend analytically the function defined by the given series into regions exterior to the region of convergence of the series. As consequences of the results obtained, certain further results pertaining to the asymptotic development of the functions in question were discussed. Reference was made to results already established by Barnes, Ford, and others regarding functions defined by power series. The speaker considered functions defined by factorial series of the first and second kinds, and by Dirichlet series. The methods of the calculus of residues was employed to solve the problem of analytic extension. Some asymptotic properties were also obtained.

5. If z^{-n} , where $z = d/dx$, is an n -fold integral operator, it can be shown that this operator is equivalent to another, i.e., $x^n Q_n(\mu)$, $\mu = xz$, which has a Taylor's expansion about $\mu = 0$. This operator is called a *generatrix function*. Both μ^{-n} and $Q_n(\mu)$ may be shown to satisfy the differential equation: $\mu Q''(\mu) + (n + \mu + 1)Q'(\mu) + nQ(\mu) = 0$. The object of the present paper is to show that the solution of the equation of heat conduction, expressed in spherical coordinates, r , θ , ϕ , is given by a function of the form: $V = F(r, t)\Theta(\theta)\Phi(\phi)Q_n(\nu)$, where $\nu = 4r^2kt$.

6. Professor Robbins presented a solution of the following problem: The grades used in a certain institution are A , B , C , and D . Suppose that the distri-

bution of grades for a certain period of time was A' , B' , C' , D' , where A' is the number of A grades etc. The grades are redefined in such a manner that it is estimated that the distribution would have been A'' , B'' , C'' , D'' , if the new definitions had been in effect during the above period of time. Suppose that the distribution of an individual for this same period was a' , b' , c' , d' . What would the distribution of this individual necessarily have been under the new definition of grades?

7. This paper was a brief resumé of the results contained in two papers published recently in the Annals of Mathematics under the titles: "Extended results in elimination," (vol. 30, pp. 92-100), and "On the resultant of two binary forms," (vol. 31, pp. 185-189). They are concerned with the problem of representing the eliminant of a definite number of the forms, where the number depends upon the dimension of the domain of definition, as a single determinant free of extraneous factors. In the first paper the question of forms in more than one set of variables was considered, and in the second, new forms of the resultant determinant of two binary forms were exhibited.

At the afternoon session of the Section a resolution was adopted expressing the sorrow of the members at the news of the sudden death of Professor W. A. Zehring of Purdue University, "who has been a faithful attendant of the Section meetings, and a zealous and enthusiastic teacher of mathematics for the past quarter of a century." A second resolution was adopted expressing the appreciation of the members of the Section for the hospitality and courtesy extended to them by President Pittenger and the members of the mathematics department of Ball State Teachers College.

In close connection with the meetings of the Section a conference on the teaching of high school mathematics was held. The conference joined with the Section for the morning program, but met separately in the afternoon.

H. T. DAVIS, *Secretary*

THE ANNUAL MEETING OF THE NEBRASKA SECTION

The annual meeting of the Nebraska Section of the Association was held at Lincoln on May 8, 1931, jointly with the mathematics section of the Nebraska Academy of Sciences. Thirty persons were in attendance, including the following members of the Association: M. A. Basoco, A. K. Bettinger, W. C. Brenke, C. C. Camp, A. L. Candy, M. M. Flood, M. G. Gaba, A. L. Hill, J. M. Howie, R. M. McDill, T. A. Pierce, Lulu L. Runge. Mr. M. M. Flood, chairman of the Section, presided.

The following officers were elected for the ensuing year: Chairman, Prof. A. K. Bettinger, Creighton University, Omaha; Secretary, Prof. A. L. Hill, Peru State Teachers College; Treasurer, Prof. J. M. Howie, Nebraska Wesleyan University.



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The Ninth Annual Meeting of the Indiana Section

H. T. Davis (Secretary-Treasurer)

To cite this article: H. T. Davis (Secretary-Treasurer) (1932) The Ninth Annual Meeting of the Indiana Section, *The American Mathematical Monthly*, 39:8, 441-445, DOI: [10.1080/00029890.1932.11987347](https://doi.org/10.1080/00029890.1932.11987347)

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However, even Eddington admits the desirability, for certain practical purposes, of using Deterministic means as a sort of "symbolic operational" method for obtaining results quickly and conveniently. For astronomical purposes, for example, we could continue to use what may be called, perhaps, "Astronomical Determinism," to calculate results, whereas for Electron Physics we could make use of the "Indeterministic" or "Secondary" Laws (as Eddington terms them), that is, the Probability Methods of the New Quantum Mechanics. Between these two extreme cases, however, there would be a set of intermediate cases. And this would lead us into logical difficulties, for the notion of Probability has no recognized place in classical Deductive Logic. Furthermore, Determinism enters the scientific arena mainly through the door of Deductive Logic, and if we are to modify Determinism we will have to modify our whole system of thinking. The necessity for such a fundamental revision of our methods of reasoning is strongly suggested in Eddington's statement that while naive realism, materialism, and the Mechanistic Hypothesis were simple, yet it was only by closing our eyes to the essential nature of experience that they could be made to seem credible. Suppose now, it were possible to construct a multiple-valued Logical System (instead of the simple Two-valued System of classical Logic, as exemplified, for instance, in Whitehead and Russell's *Principia Mathematica*) of such a sort that it could constitute a valid and satisfactory basis for a whole set of distinct Theories of Sets; then the way would be open for the introduction of the notion of Probability into Deductive Logic, and the logical difficulties mentioned above might be smoothed out. Now, as a result of the work of Chwistek (*Mathematische Zeitschrift*, Vols. 26 and 30), and of Lesniewski, Tarski, Lukasiewicz, Greniewski, and others, together with the fundamental work of Korzybski (a forthcoming book by him will explain the work of the Polish School), a start in this direction has already been made, and a multi-valued system has actually been constructed, and looks to be very promising for the purposes mentioned.

12. This paper discusses the process of "rounding off" as applied to numbers, the absolute and relative errors in sums, differences, products and quotients. Mention is made of the accuracy in connection with logarithms and trigonometric functions. The reverse problem is taken up, namely, the allowable error in the data if there is a certain desired accuracy in the result.

W. W. RANKIN, *Secretary*

THE NINTH ANNUAL MEETING OF THE INDIANA SECTION

The ninth annual meeting of the Indiana Section of the Mathematical Association of America was held on Friday and Saturday, May 6, and 7, 1932, at Butler University, Indianapolis, Indiana.

There were sixty present at the meeting including the following twenty-six members of the Association:

Gladys L. Banes, G. A. Bliss, Stanley Bolks, G. E. Carscallen, H. T. Davis, J. E. Dotterer, W. E. Edington, P. D. Edwards, E. D. Grant, G. H. Graves, H. E. H. Greenleaf, F. H. Hodge, H. K. Hughes, E. N. Johnson, E. L. Klinger, Juna M. Lutz, T. E. Mason, H. A. Meyer, T. W. Moore, Eunice C. Orr, Saul Pollock, J. A. Reising, C. K. Robbins, L. S. Shively, R. O. Virts, K. P. Williams.

On Friday afternoon at 5:30 a reception was given to the visiting members and their guests which was followed by a banquet attended by fifty-five persons. Dean J. W. Putnam of Butler University officiated as toast master and made an address of welcome to the members of the Section and their guests. Responses were made by Professor Carscallen of Wabash College, chairman of the Section, Professor Edington of De Pauw University and Professor Cora B. Hennel of Indiana University.

At 8:15 a public lecture was given by Professor G. A. Bliss of the University of Chicago on the subject, "The Structures of Pure and Applied Mathematical Sciences." In this address Professor Bliss characterized pure mathematical science as consisting of postulates, definitions, and theorems. The theory of the real number system based upon four simple postulates for positive integers was cited as an example. The structure of an applied mathematical science is similar except that the usefulness of the theory depends upon the accuracy with which the postulates correspond to simple observed data, and the logical conclusions of the theory to the results of more complicated observations. It is not true that there is a unique mathematical theory for the correlation of a particular set of natural phenomena. On account of the looseness of the fit between theory and observation, which is always present, a multiplicity of theories for the correlation of the same set of observed data is always possible. Euclidean and non-Euclidean theories of plane geometry, the Ptolemaic and Copernican theories in astronomy, and the various quantum theories were described briefly as illustrations.

Following the address of Professor Bliss, Professor Saul Pollock, of the Indiana State Teachers' College at Terre Haute, gave a public exhibition of "Skew Curve Projection." This exhibition consisted in the creation of space curves by throwing light upon string models of various types of surfaces. By means of the device of photographing curves of high order and using these lantern slides in turn to generate new space curves, it was possible to obtain curves of remarkably high orders.

At the session on Saturday morning, presided over by Professor G. E. Carscallen, Wabash College, chairman, the following officers were elected: Professor K. P. Williams, Indiana University, Chairman; Professor Juna M. Lutz, Butler University, vice-Chairman; Professor H. T. Davis, Indiana University, Secretary-Treasurer.

A chairman's address was made by Professor G. E. Carscallen on the subject, "The Pathology of Mathematics." In this address Professor Carscallen called attention to the fact that "educational research" during the past two or

three decades has encroached by leaps and bounds upon other departments in college and university curricula. This encroachment presents to mathematics in particular an especial menace, since too many people, ignorant of its aims and unappreciative of its importance, have attempted foolish modifications of the mathematics courses both in intermediate and college teaching. Present low standards of attainment by graduates are attributable to these causes. The speaker cited the lowered standards of the North Central Association with regard to mathematics as an evidence of this dangerous trend. Professor Carscallen particularly urged the members of the Indiana Section to take a more vigorous part in the framing of curricula and in other activities where the cause of mathematics could be more effectively defended.

By special invitation Dr. Cornelius Lanczos of Frankfort University, Germany, and Purdue University, made an hour's address on the subject, "An Elementary Development of Riemannian Geometry with Application to Relativity." In this address Dr. Lanczos considered the geometry of the line element, $ds^2 = g_{11}dx_1^2 + 2g_{12}dx_1dx_2 + g_{22}dx_2^2$, and showed how interpretations in Euclidean geometry could be generalized in the Riemannian and Lobachevskian cases. Making use of the variation principle applied to the line integral $I = \int ds$, the speaker showed how the mechanics of the Keplerian orbits could be obtained as an interpretation of the geometrical picture. Proceeding from this elegant discussion, the speaker carried the generalization into four dimensions and showed how the mechanics of the Einstein physics came as a natural consequence of the geometrical considerations.

The remainder of the program consisted of the following papers. Due to illness Professor Heath was unable to give his paper, but was represented by George Manning of Franklin College.

1. "A study in Keplerian elliptic motion" by M. Wiles Keller, Indiana University, by invitation.
2. "Functions analogous to Hermite polynomials in the problem of curve fitting" by Professor H. E. H. Greenleaf, De Pauw University.
3. "Language, logic, and mathematics" by Dr. A. F. Bentley, Paoli, Indiana, by invitation.
4. "Maxima and minima of radii of curves" by Professor F. H. Hodge, Purdue University.
5. "Some composite polyhedrons" by Professor D. H. Heath, Franklin College.
6. "A new technique in the analysis of trend lines" by Professor H. T. Davis, Indiana University.
7. "Higher geometry in the college curriculum" by Professor J. E. Dotterer, Manchester College.
8. "Some elementary geometrical applications of group theory" by Professor W. E. Edington, De Pauw University.

Abstracts of the papers follow, the numbers corresponding to the list of titles.

1. In this paper the expression for the angular velocity about a point between the foci in Keplerian elliptic motion was determined and the cubic equation derived, the roots of which give the values for which the angular velocity is a maximum and a minimum. Some of the properties of this cubic, the coefficients of which depend upon two parameters, were given and their relationship to the angular velocity noted.

2. Professor Greenleaf discussed the least-square approximation to data in which the variates are equally spaced and the observed frequencies are given the binomial coefficients as weighting factors. By a method parallel to the Gram-Charlier development of continuous variates in the type-A curve, a set of functions analogous to the Hermite polynomials were found for discrete variates. These functions have a generating function and a recurrence formula; each satisfies a given difference equation of second order, and has an orthogonality property similar to that of the Hermite polynomials. The coefficients to be used with these functions are computed and tabulated, permitting the determination of the least-square equation with a minimum amount of computation.

At the close of the paper Professor E. H. Hildebrandt of De Pauw University discussed these functions showing how they fit into the general system of polynomials connected with the Charlier expansion, using his paper published in the Annals of Mathematical Statistics, November, 1931, as the basis of his discussion.

3. Dr. Bentley undertook to show the manner in which language, logic and mathematics may be inspected as differentiated aspects of that historical field of human behavior, indicated by the word "knowledge" and by various associated terms. For the investigation of this common field a procedure to be called "Semantic Analysis" was suggested as wider in scope and more powerful than logic. Semantic Analysis in this sense is closely akin to Korzybski's Non-Aristotelian Semantics, but basically different from Chwistek's Semantik. The recent trend towards the reconstruction of logic in the work of Russell, Hilbert, Brouwer, Chwistek, Lukasiewicz, Tarski, Lesniewski and Korzybski was briefly sketched.

4. In testing for the maximum or minimum values of the radius of curvature of the parabola, $y^2 = 4ax$, differentiation with respect to x fails to indicate the origin as a critical point while differentiation with respect to y does indicate this point. In the case of the ellipse in standard form, differentiation with respect to x indicates one pair of points while differentiation with respect to y indicates another pair. Similar results are found for the hyperbola. The aim of this paper is to point out the apparent exceptions to ordinary rules and to indicate the reasons for these conditions.

5. In this paper models were presented showing families of solids formed by the combinations of the regular convex polyhedrons. Professor Heath presented to the members of the Association pamphlets of patterns for the construction of twelve of these solids, as, for example, the formation of a solid composed of equal octohedrons mounted on each face of an icosahedron.

6. In the analysis of series of economic items, as, for example, the Dow Jones stock market averages, pig iron production, etc., it is desirable to have a technique for fitting trend lines of higher degree than the straight line and also to be able to compute the correlations of the deviations of these series from their trend lines. By means of simple formulas involving quadratic forms of the moments of the series it is possible to solve this problem in the sense of least squares. Explicit formulas for the coefficients of the forms in terms of the number of items and tables of their values are given for polynomials from the first to the seventh degrees inclusive. The speaker indicated the application of these formulas in an elaborate computation of economic constants which is being made by the Cowles Commission for Research in Economics of Colorado Springs, an affiliate of the Econometric Society.

7. In this paper Professor Dotterer presented the case of higher geometry in the college curriculum. He indicated the scope of this subject which seems desirable for presentation to undergraduates and pointed out the many contacts which this study makes with other mathematical disciplines.

8. In this paper Professor Edington discussed the results obtained by permuting the coefficients of such equations as $y=ax^2+bx+c$, $x^2+y^2+ax+by+c=0$, $ax+by+c=0$, and indicated the generalizations and some of the geometrical relations associated with group concepts. It was also pointed out that Veronese in 1881 had discovered that the permutations of the homogeneous coordinates of a point in a plane gave six points which are the vertices of a Pascal hexagon, and Professor Edington showed that the plane is divided up into regions such that if a point is taken from a given region, the kind of conic determined by the six points is always of the same kind. The extension to space was also indicated.

Resolutions were adopted by the members of the section expressing their appreciation and thanks to the authorities of Butler University for their hospitality, to Professor Bliss, Professor Pollock, and Professor Lanczos for their contributions to the program, and to the Mathematics Section of the State Teachers' Association and the Extension Division of Indiana University for their efforts in stimulating mathematical study through the recently inaugurated state wide contest in mathematics for high school study.

H. T. DAVIS, *Secretary-Treasurer*

THE THIRTEENTH ANNUAL MEETING OF THE ILLINOIS SECTION

The thirteenth annual meeting of the Illinois Section of the Mathematical Association of America was held at the University of Illinois, on Friday and Saturday, May 6 and 7, 1932.

The attendance was about ninety, including the following forty-five members of the Association: Beulah M. Armstrong, Edith I. Atkin, H. W. Bailey,



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The Tenth Meeting of the Indiana Section

P. D. Edwards (Secretary)

To cite this article: P. D. Edwards (Secretary) (1933) The Tenth Meeting of the Indiana Section, The American Mathematical Monthly, 40:7, 394-398, DOI: [10.1080/00029890.1933.11987463](https://doi.org/10.1080/00029890.1933.11987463)

To link to this article: <https://doi.org/10.1080/00029890.1933.11987463>



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$$Y - \bar{Y} = \frac{\sigma_y^2 - \sigma_x^2 + \sqrt{(\sigma_y^2 - \sigma_x^2)^2 + 4p^2}}{2p} (X - \bar{X}),$$

where $p = r\sigma_x\sigma_y = \sum(X_i Y_i)/n - \bar{X}\bar{Y}$. The median regression line which makes the sum of the absolute values of the distances from the line a minimum is unsuitable because it is not always unique. If unique it usually passes through one or more of the original points with about the same number on either side. By holding one point fixed one may easily estimate by using horizontal distances whether rotation to right or left will diminish the sum of the perpendicular distances. Weighted points count as multiple points. However, this line does not fit in so well with ordinary probability theory as the absolute regression line defined above.

4. The purpose of Mr. Thompson's paper was to present parametric solutions of two very general Diophantine equations,

$$X_1^2 + X_2^2 + X_3^2 + \cdots + X_p^2 = W^n$$

and

$$X_1^2 + a_1 X_2^2 + a_2 X_3^2 + \cdots + a_{p-1} X_p^2 = Y_1^2 + b_1 Y_2^2 + b_2 Y_3^2 + \cdots + b_{n-1} Y_n^2.$$

The solutions were obtained directly from the stated problem in terms of independent parameters, thus obtaining multiple infinitudes of solutions, according to the number of parameters involved.

6. This is a field formed by taking one-rowed matrices of three elements each with multiplication \cdot , and addition $+$, defined as follows: $(a, b, c) + (x, y, z) = (az + 2by + cx, bz + cy, cz)$; and $(a, b, c) \cdot (x, y, z) = (ax, by, cz)$; $(a, b, c) = (x, y, z)$, if $x/a = y/b = z/c$.

7. Professor Earl's paper considers the approximation to a given function of two variables by means of a sequence of polynomials which are determined so as to minimize the integral over an unbounded region of the product of a non-negative weight function and the m th power of the magnitude of the error.

A. L. HILL, *Secretary*

THE TENTH MEETING OF THE INDIANA SECTION

The tenth meeting of the Indiana Section of the Mathematical Association of America was held Friday and Saturday, May 5 and 6, 1933, at Indiana University, Bloomington, Indiana.

There were forty-two registered for the meetings on Saturday including the following twenty-one members of the Association:

Gladys L. Banes, H. T. Davis, W. E. Edington, P. D. Edwards, E. D. Grant, E. H. C. Hildebrandt, F. H. Hodge, E. L. Klinger, Mayme I. Logsdon, Florence Long, Juna M. Lutz, H. A. Meyer, T. W. Moore, J. A. Reising, C. K. Robbins, Fred Robertson, D. A. Rothrock, L. S. Shively, H. E. Slaught, R. O. Virtts, K. P. Williams.

On Friday evening an informal reception was held in the East Parlors of the Student Building for arriving members and their guests. At six o'clock a dinner was held in the Grill room of the Indiana Union Building. Professor K. P. Williams acted as toastmaster. Short talks were given by Professor Fernandus Payne, Dean of the Graduate School and head of the department of zoology, and by Professor H. E. Slaught of the University of Chicago. At eight o'clock Professor Slaught gave a public lecture on the subject: "The lag of mathematics behind literature and art in the early centuries." This lecture was later given on the program of the national meeting of the Mathematical Association of America held in Chicago in June and an account of it will appear in the report of that meeting.

The meeting on Saturday was presided over by Professor K. P. Williams of Indiana University, chairman of the Section. At the business meeting the following officers were elected: Chairman, Professor Juna M. Lutz, Butler University; Vice-Chairman, R. O. Virts, Central High School, Fort Wayne; Secretary-Treasurer, Professor P. D. Edwards, Ball State Teachers College.

The retiring chairman's address was given by Professor Williams on the subject, "Early theories of comet orbits." Professor Williams presented the important phases of the early theories and gave especial attention to the very great difficulties involved in the calculation of orbits. Many of the solutions by first rate mathematicians have been all but useless to the practical astronomer because of the extreme difficulty of carrying out the necessary calculations.

The following papers were presented:

1. "Dynamic symmetry" by Professor S. A. Cain, Department of Botany, Indiana University, by invitation.
2. "The Mathematical Association and a decade of mathematics in Indiana" by Professor W. E. Edington, De Pauw University.
3. "Concerning modular functions" by Professor W. E. Maier, Purdue University, by invitation.
4. "Some elementary formulas suggested by an elementary equation in trigonometry" by Professor F. H. Hodge, Purdue University.
5. "The expansion of an arbitrary operative function in successive derivatives" by Professor Fred Robertson, Iowa State College.
6. "Polar line coordinates" by Professor C. K. Robbins, Purdue University.
7. "Some applications of periodogram analysis" by P. W. Overman, Indiana University, by invitation.

Abstracts of the papers follow, the numbers corresponding to the numbers in the list of titles.

1. The term "dynamic symmetry" was coined by Professor Jay Hambidge to describe some of the relationships he discovered in Greek art of the Classical Period. His later researches led to its discovery in ancient Greek writings. It had failed of translation because moderns had no concept of the meaning until Hambidge had developed it, by an analysis of art objects, as a system of pro-

portion probably used consciously by the Greeks in the construction of art and architectural objects. The underlying theme is that of root-rectangular areas and a peculiar area, the whirling-square rectangle, which are manipulated so as to form *commensurate areas* and gnomens by diagonals and perpendiculars—the construction being such as largely to control the "idea" of the art object as to form, and, to a certain extent, ornament. The end and side of the whirling-square rectangle are as 1 to 1.618. This has been called the ϕ ratio and is found in many diversified phenomena. The root rectangles have 1 as their end and $\sqrt{2}$, $\sqrt{3}$, $\sqrt{5}$, as their sides.

The Greeks probably got the proportions from the ancient Egyptians as the ϕ ratio has been found in the pyramids dating back as far as 4700 B.C. The ϕ ratio rectangle and its reciprocal equal the root-five rectangle, both of which, along with the other root-rectangles, could have been obtained from a square by at least two simple methods of construction used by Egyptians in the "cording of the temple." Why these proportions are "good" in art it is difficult to say, but many modern artists and craftsmen have found it profitable to employ the methods in manipulation of their ideas for designs.

It is truly a remarkable phenomenon that the ϕ ratio should be found as a fundamental underlying theme in the architecture of plants, especially in phyllotaxy, the arrangement of leaves on the stem. Most leaves are arranged in a spiral system the relations of which form a numerical series known as the Fibonacci summation series, running 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, the ratio of which converges on 1.618, the ϕ ratio. This series has been known for centuries but the explanation has only recently been found by A. H. Church of Oxford in continued proportionate growth of leaf primordia arranged in curve systems on a conic-ovoid growing point. The ubiquitous spiral in nature has been the subject of many interesting speculations and studies and is frequently logarithmic in nature, due in the main to growth phenomena.

The ϕ ratio is also that of Euclid's proposition, to cut a line in extreme and mean proportion, the so-called Golden Section. There have been many formulae of beauty, perfect figures and more or less mystical obsessions held by philosophers of the past and almost any good art will permit of analysis leading to formulae and approaching scientific exactness, but that is certainly neither the whole explanation nor the sole need for creative work. That the ϕ ratio should have been used by the ancient Egyptians and the classical Greeks in the production of good art, constitute the Golden Section, be inherent in the root-five rectangle and other geometrical figures, and constitute one of the most wide spread of botanical phenomena is without any correlating explanation.

2. The history of the Mathematical Monthly and the problems of its publication were sketched briefly in order to show how the problem of its continuation led up to the conception and organization of the Mathematical Association through the combined efforts of the founder of the Monthly, B. F. Finkel, and the three active organizers, H. E. Slaught, E. R. Hedrick and W. D. Cairns. Some original correspondence concerning the charter membership was shown.

The Indiana Section of the Association was reorganized on an active basis on October 16, 1924, at Indianapolis, and has since met regularly in the spring at the various universities and colleges over the state. The programs have always included addresses by speakers of note among whom have been Jacques Hadamard, of Paris, F. R. Moulton, Jacob Kunz, D. W. Moorehouse, Warren Weaver, L. C. Karpinski, T. C. Fry, G. A. Bliss, Cornelius Lanczos, and H. E. Slaught.

The membership of the Section has increased from 30, in 1916, to 65 according to the last directory. A total of 20 research papers by members of the Section have been published in reputable mathematical journals during the past decade. The interest aroused by the meetings of the Section has led to the formation of several undergraduate mathematical clubs in the colleges of Indiana. The advances made in recent years in the development of graduate study in the state was pointed out and the fact that six Ph.D. degrees with mathematics as a major were conferred in the state during the past four years was presented as evidence of general quickening in mathematical interest no little part of which may be attributed to the work of the Indiana Section of the Association.

3. Let $0 < F(\omega)$ and $e^{\tau i\omega} = q$. The classical identity

$$\left(\sum_{v=-\infty}^{\infty} q^{v^2} \right)^2 = 2 \sum_{n=-\infty}^{\infty} \frac{q^n}{1 + q^{2n}}$$

was proved in a new way due to the fact that, generally,

$$\begin{aligned} & \lim_{l \rightarrow \infty} \sum_{0 < h+k < l} \frac{(-1)^h}{2h+1+2k\omega} \\ &= \lim_{l \rightarrow \infty} \sum_{0 < h+k < l} \frac{(-1)^k}{2h+(2k+1)\omega} \cdot \begin{cases} i & \text{if } \begin{cases} 0 < F(\omega) \\ 0 > F(\omega) \end{cases} \\ -i & \text{if } \begin{cases} 0 > F(\omega) \\ 0 < F(\omega) \end{cases} \end{cases} \end{aligned}$$

4. Starting with the identity $\cos 20^\circ \cos 40^\circ \cos 80^\circ = 1/8$ this paper gives several methods of proving this identity with several general formulas together with proofs suggested by the methods of proof for the original identity.

5. The problem is the determination of a method of expanding an arbitrary operative function $f(x, z)$ in a series of successive powers of z . The symbol z shall be interpreted to mean the operational derivative d/dx and its powers the corresponding successive derivatives.

The components z^i define the function $f(x, z)$. These component functions are grouped according to the formula of Schmidt for the discovery of a normalized orthogonal system of functions by linear combinations of the given set.

The function is then expanded in the Fourier manner in terms of these functions $\phi_i(z)$ for the range $0 < z \leq 1$ of the independent variable. The resulting series is then rearranged in terms of the successive powers of z .

The expansion is stated thus,

$$f(x, z) = \sum_{n=1}^{\infty} A_n(x) \sum_{i=1}^n \sum_{\alpha} (-1)^{\beta+i+1} \frac{1}{N_{n,\dots,\beta,\dots,i}} z^i$$

where

$$A_n(x) = \int_0^1 f(x, z) \phi_i(z) dz$$

and α is every possible combination of $(n-1) \dots (i+1)$ in the order given, β is the number of indices omitted, $(\beta=0, 1, \dots, n-i-1)$ and $1/N_i$ is the reciprocal of the square root of the norm if the index is not repeated but is the product of these expressions by $\int_0^1 \phi_i(z) z^i dz$ when the index is repeated.

6. The ordinary polar coordinates of a point also determine a line perpendicular to the radius vector at its end point and may, therefore, be thought of as the coordinates of this line.

To find the polar line coordinate equation of any curve, express its pedal curve in polar coordinates. This type of coordinates proved to be extremely cumbersome in practise but some of the by products turned out to be both new and interesting. For example, if, to three lines through a point perpendiculars of lengths a, c and b are dropped from another point then $c \sin(A+B) = a \sin A + b \sin B$ where A is the angle between b and c , and B the angle between a and c .

7. In this paper the theory of the Schuster periodogram was developed. Applications were shown to such divergent subjects as sun-spots, weather changes, market fluctuations, recurrence of earthquakes, stellar variations, magnetic disturbances, etc. The speaker announced the completion of an elaborate set of tables for the computation of periodograms. Values of $\sin \theta$ and $\cos \theta$, $\theta = 2\pi s/u$, have been computed to 8 decimal places for s from 0 to u , and u from 5 to 75 by integers.

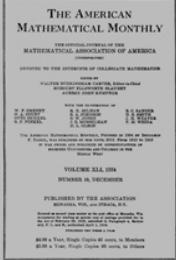
At the afternoon session of the Section a resolution was adopted expressing the appreciation of the members of the Section for the hospitality and courtesy extended to them by the members of the mathematics department of Indiana University.

P. D. EDWARDS, *Secretary*

THE MAY MEETING OF THE MARYLAND—DISTRICT OF COLUMBIA—VIRGINIA SECTION

The May meeting of the Maryland—District of Columbia—Virginia Section of the Mathematical Association of America was held at the University of Virginia on Saturday, May 13, 1933.

Sixty-three persons attended the meeting including the following forty-two members of the Association: O. S. Adams, M. W. Aylor, Archie Blake, J. W. Blincoe, W. E. Byrne, Paul Capron, Orpha A. Culmer, Tobias Dantzig, Alexander Dillingham, J. A. Duerksen, W. H. Echols, Mary Ewin, P. J. Federico,



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The Eleventh Meeting of the Indiana Section

P. D. Edwards (Secretary)

To cite this article: P. D. Edwards (Secretary) (1934) The Eleventh Meeting of the Indiana Section, *The American Mathematical Monthly*, 41:10, 593-596, DOI: [10.1080/00029890.1934.11987654](https://doi.org/10.1080/00029890.1934.11987654)

To link to this article: <https://doi.org/10.1080/00029890.1934.11987654>



Published online: 13 Mar 2018.



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THE ELEVENTH MEETING OF THE INDIANA SECTION

The eleventh meeting of the Indiana Section of the Mathematical Association of America was held on Friday and Saturday, May 11–12, 1934, at Purdue University, Lafayette, Indiana.

There were forty-one registered for the meetings on Saturday including the following twenty-seven members of the Association: Stanley Bolks, J. H. Butchart, H. T. Davis, C. S. Doan, J. E. Dotterer, W. E. Edington, C. H. Frick, E. D. Grant, G. H. Graves, W. R. Hardman, C. T. Hazard, F. H. Hodge, H. K. Hughes, E. L. Klinger, Juna M. Lutz, William Marshall, T. E. Mason, Gertrude I. McCain, Gladys (Banes) McColgin, H. A. Meyer, G. T. Miller, J. A. Reising, C. K. Robbins, L. S. Shively, R. B. Stone, Anna K. Suter, K. P. Williams.

On Friday evening a joint dinner meeting was held with the Purdue chapter of Sigma XI and the Indiana Association of College Physics Teachers. Following the dinner there was a public address by Professor R. D. Carmichael of the University of Illinois on the subject "Consonance of thought and things." Professor Carmichael's paper contains a contribution to a problem in the philosophy of science, namely, the problem of the extent of agreement which exists between the relations connecting phenomena in experience on the one hand, and on the other the relations connecting the elements of thought when presented in deductive form.

The sessions on Saturday were presided over by the retiring chairman, Professor Juna M. Lutz. At the business session the following officers were elected: Chairman, Professor T. E. Mason, Purdue University; Vice-Chairman, Professor H. A. Meyer, Hanover College; Secretary, Professor P. D. Edwards, Ball State Teachers College.

At the afternoon session a resolution was passed expressing the sorrow of the members because of the death of Professor E. N. Johnson of Butler University. Professor Johnson was one of the charter members of the Indiana Section and served as the Chairman in 1927. A second resolution expressed the appreciation of the members of the Section of the courtesy extended them by the members of the staff of Purdue University and to Professor Carmichael and to Professor Roys for their addresses.

The following papers were presented at the Saturday sessions.

1. "The need for mathematical training in the biological and social sciences" by the retiring chairman, Professor Juna M. Lutz, Butler University.
2. "An engineer looks at mathematics" by Professor Carl S. Roys, Department of Electrical Engineering, Purdue University, by invitation of the Program Committee.
3. "The bearing of college mathematics on the teaching of secondary mathematics" by Professor K. P. Williams, Indiana University.

4. "A vacation among mathematicians" by Professor T. E. Mason, Purdue University.
5. "An experiment with student criticism" by Professor G. H. Graves, Purdue University.
6. "Properties of the polygamma function" by Professor H. T. Davis, Indiana University.
7. "On the asymptotic development of analytic functions" by F. C. Smith, Fort Wayne, by invitation.
8. "Helices in Euclidean n-space" by Dr. J. H. Butchart, Butler University.
9. "Ghost waves and negative energy" by A. W. Pershing, Indiana University, by invitation.

Abstracts of the papers follow, the numbers corresponding to the numbers of the papers:

1. In the opinion of the mathematician, there are valuable applications of his theory in all fields. To what extent do others share his view? In particular, many examples in the biological and social sciences can be found where quantitative methods indicate underlying laws which were uncertain or obscure when the qualitative method of description only was used. Some specialists in these fields are convinced that mathematical training is desirable or even essential, but they seem to be in the minority. The result of a questionnaire which was sent to the heads of the departments of biology and social science in a number of the larger universities indicates that there is still no general need felt for such training. Few schools require any collegiate mathematics of their majors in these subjects, and graduate students are usually advised to take such courses only when their thesis work requires it. Some have advocated special mathematical courses in preparation for work in these sciences. Which topics should be included in these courses, which ones omitted, and whether these brief courses would be sufficient to supplant the conventional ones are open questions. The responsibility of proving the practical value of his subject rests partly upon the college teacher of mathematics. It is his duty to discover as many of the applications of his theory as possible and to show his students and associates in other fields that it is a necessary and vital factor in the advancement of all scientific knowledge.

2. By way of introduction, Professor Roys brought out the fact that the theory of Electrical Engineering has always been characterized by the gradual reduction of the older phases of the subject to an exact science, together with a rapid expansion in the field of application. This has resulted in a larger proportion of the electrical engineers requiring a training today that is at once more extensive and analytical than has been required in the past. The part played by the mathematician in training the engineer, together with his development of new operations many years in advance of possible applications to material problems was discussed.

Mathematics was treated as a "tool," "a system of shorthand notation," and as a research method following the lines of either inductive or deductive

reasoning. Many illustrations from engineering practice and teaching experience were cited that show the advantages of the analytical method as well as the possibilities of arriving at erroneous results if the work is too completely divorced from practical considerations. The ability to consider on paper the effect of varying a single factor at a time, in contrast to the futility, in many cases, of even attempting such a procedure in the laboratory, was especially emphasized.

In conclusion, a number of research topics were suggested whose solutions would require not simply a close cooperation between an engineer and a mathematician, but rather the combined efforts of an engineer-mathematician and a mathematician-engineer. This led to an advancement of the idea that a major line of study should be offered in engineering schools that would be known as Mathematical Engineering, corresponding to the present Mathematical Physics in schools of science.

3. The importance of an active interest on the part of the mathematicians of the state in the mathematics of the secondary schools was discussed and a committee is to be appointed to formulate plans for the Indiana Section of the Association to take the initiative in stimulating greater interest in mathematics.

4. Professor Mason related some incidents of his stay at Cambridge University and his attendance at the International Congress of Mathematicians at Zurich.

5. For the past nine years, Professor Graves has made a practice of asking students to criticize, under conditions insuring anonymity, the course they have had. This is in the belief that teachers need to know what students are thinking about their courses and to impress upon students the fact that their relation to their own education is much broader than merely following a prescribed series of lessons.

Since the experiment started, Professor Graves' method of administering courses has been extensively modified.

6. In this paper the author discussed the properties of the polygamma functions, namely the n th derivatives of $\psi(x) = d \log \Gamma(x)/dx$. Special attention was paid to the asymptotic expansion of the zeros of these functions on the negative real axis. The theorem of Gauss for the computation of values of $\psi(x)$ at rational points in the interval $(0,1)$ was extended to the polygamma functions. Announcement was made that the statistics laboratory of Indiana University has completed tables of the trigamma, tetragamma, pentagamma, and hexagamma functions from $x = -10$ to $x = 100$ at intervals from .01 to .1 to 10 and 15 significant figures, eight thousand values in all. This computation required auxiliary tables from 16 to 18 significant figures of $1/x^n$, $n = 2, 3, 4, 5$, for the first thousand integers. Work on the pentagamma and hexagamma tables was largely carried out by E. B. Morris and Lucy C. Kantz.

7. During the years 1900–1908, E. W. Barnes obtained the asymptotic developments of a large number of function types by means of highly specialized

methods. In more recent years, general methods of determining such asymptotic expansions have been developed by W. B. Ford and C. V. Newsom. In this paper F. C. Smith used the general theory in considering the asymptotic behavior of the following function types:

$$(1) \quad f(z) = \sum_{n=0}^{\infty} \frac{z^n}{(n+\theta)^{\beta}}; \quad (2) \quad f(z) = \sum_{n=0}^{\infty} \frac{h(n)z^n}{\Gamma(n+P)}.$$

8. A necessary and sufficient condition for a curve in three dimensions to be a helix is that the ratio of the first and second curvatures be constant. This condition is generalized for a curve in n -space and the author then takes up some properties of helices and associated curves termed pseudo-helices.

9. Mr. Pershing discussed the mathematical theory and physical interpretation of deBroglie waves. He showed the connection between Fermat's principle in the classical optics and the principle of least action. He indicated that the maximum velocity c in free space as postulated in relativity is true only for the motion of real energy packets. A simple derivation of the Bohr atom from the deBroglie equation was given and the relativistic formulation of the Schrödinger hydrogen atom was converted to the Bohr form by a simple reduction to the equation of matter waves. His correlation of the orbital frequency of an electron, material wave frequency, and radiated frequency was described. The speaker discussed the quantization of the space time continuum and made application of the Fermi Dirac statistics to negative energy states. Holes in space were interpreted as real entities with apparent masses, and the extension made of ghost waves to virtual and negative masses.

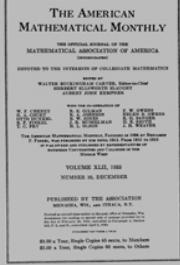
P. D. EDWARDS, *Secretary*

THE ANNUAL MEETING OF THE MINNESOTA SECTION

The annual meeting of the Minnesota Section of the Mathematical Association of America was held at St. Olaf College, Northfield, Minnesota, on Saturday, May 12, 1934. Sessions were held at 11:00 o'clock and at 2:15 o'clock with a luncheon at 12:45 o'clock.

Professor C. S. Carlson, chairman of the Section, presided at the two sessions, except when Professor R. W. Brink relieved the chairman during the presentation of his own paper. Seventy-five persons attended the meeting including the following thirty members of the Association: Sister Mary Aloysius, C. J. Blackall, Jessie W. Boyce, R. W. Brink, L. E. Bush, W. H. Bussey, C. S. Carlson, L. L. Cruise, H. H. Dalaker, Margaret C. Eide, C. H. Fischer, Gladys Gibbens, C. H. Gingrich, Borghild Gunstad, W. L. Hart, H. E. Hartig, E. Marie Hove, Dunham Jackson, C. M. Jensen, W. H. Kirchner, Marie M. Ness, M. G. Scherberg, A. J. Strane, F. J. Taylor, Ella Thorp, A. L. Underhill, O. E. Walder, Marion B. White, Marian A. Wilder, G. L. Winkelmann; and Sister Thomas à Kempis, institutional member representative.

At the afternoon session a vote of thanks was adopted as a sign of appreciation of the cordial hospitality of St. Olaf College, and the efforts of its depart-



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The May Meeting of the Indiana Section

P. D. Enwards (Secretary)

To cite this article: P. D. Enwards (Secretary) (1935) The May Meeting of the Indiana Section, The American Mathematical Monthly, 42:10, 587-590, DOI: [10.1080/00029890.1935.11987775](https://doi.org/10.1080/00029890.1935.11987775)

To link to this article: <https://doi.org/10.1080/00029890.1935.11987775>



Published online: 13 Mar 2018.



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THE MAY MEETING OF THE INDIANA SECTION

The twelfth meeting of the Indiana Section of the Mathematical Association of America was held Friday and Saturday May 3-4, 1935, at Clifty Falls State Park, Madison, Indiana, and Hanover College, Hanover, Indiana.

A total of seventy-six from seventeen schools registered, including the following twenty-five members of the Association: P. P. Boyd, J. H. Butchart, H. T. Davis, J. E. Dotterer, Olive M. Draper, W. E. Edington, P. D. Edwards, E. D. Grant, G. H. Graves, S. G. Hacker, Laurence Hadley, W. R. Hardman, C. T. Hazard, Cora B. Hennel, H. K. Hughes, Florence Long, Juna M. Lutz, T. E. Mason, H. A. Meyer, G. T. Miller, Mary S. Paxton, L. S. Shively, W. O. Shriner, Anna K. Suter, and K. P. Williams.

At the business session the following officers were elected for next year: Professor H. A. Meyer, Hanover College, Chairman; Professor P. D. Edwards, Ball State Teachers College, Secretary.

It was decided to hold a meeting of the Section in connection with the fall meeting of the Indiana Academy of Science to be held at Wabash College, Crawfordsville, Indiana, in November. The spring meeting of 1936 will be held at Manchester College, North Manchester, Indiana.

A committee appointed in 1934 to formulate plans to encourage and recognize well prepared teachers of secondary mathematics made its report. The committee suggested that the Indiana Section of the Association create a "Certificate of Merit in Mathematical Preparation" to be awarded on the basis of examinations taken by prospective teachers before graduation. The report was adopted and the committee instructed to work out details for holding the first examinations during the school year 1935-1936. Professor K. P. Williams of Indiana University is chairman of the committee.

A dinner was held Friday evening at the Inn in Clifty Falls State Park. The visitors were welcomed by Professor Meyer of Hanover College. After the dinner a program was given by members of the mathematics department of Purdue University, the first number of which was the address of the retiring chairman, Professor T. E. Mason: "Is there a popular appeal in mathematics?"

Professor Mason gave a number of instances showing a wide interest in numbers and things mathematical. He believes that teachers of mathematics should take advantage of this interest to develop interest in their subject matter. This is possible in the elementary school, in the high school, and in the college. The natural sciences are making increasing use of mathematics. Economic and educational studies are becoming more and more statistical. Hence, the individual who does not elect to study mathematics is limited more and more in the fields of work that he may enter. This brings to the teacher of mathematics the responsibility for using all possible means of interesting students in the subject matter so that those with ability shall not shun mathematics because of lack of interest.

After Professor Mason's address the following series of papers were given as

suggestions to teachers for awakening popular interest in mathematics:

1. "Driving across the solar system" by Professor Laurence Hadley.
2. "As we number our days" by Professor C. T. Hazard.
3. "Getting out of our own world" by Professor G. H. Graves.
4. "An example of symbolism" by Stanley Bolks, introduced by Professor Mason.

5. "The gambler's chance" by G. T. Miller.

6. "The highly honored elephant" by Professor H. K. Hughes.

7. "The tiring irons" by Neil Little, introduced by Professor Mason.

8. "String figures" by W. R. Hardman.

Abstracts of the papers follow.

1. Professor Hadley built the solar system in miniature with the sun at the monument in the Circle at Indianapolis and with Pluto not far from Clifty Falls.

2. Professor Hazard gave a brief historical sketch of the development of the calendar and made some observations on current proposals to reform it.

3. Professor Graves pointed out that the study of geometry, particularly of four dimensions, gives one experience in drawing conclusions from unfamiliar assumptions. By proper attention to transfer of training, a contribution may be made toward meeting the conditions of life in a rapidly changing world.

4. Mr. Bolks showed some examples of the symbolism used by mathematicians of the seventeenth century and illustrated their method of extracting roots.

5. Mr. Miller gave some examples to show that from a mathematical point of view the gambler with limited capital always loses.

6. Professor Hughes discussed a problem, given in an Algebra of 1692, in the form of a story about a pet elephant belonging to a king. The method and notation used in solving the problem seem very clumsy to us of the present.

7. Mr. Little gave a brief description of the ancient puzzle of the Tiring Irons, demonstrated its operation, and applied mathematics to the solution of a problem concerning it.

8. Mr. Hardman discussed briefly the nature and history of string figures, and demonstrated the method of construction of some of the simpler types.

The session on Saturday morning was held at Hanover College. The following papers were presented:

1. "Reminiscences of forty-four years as a teacher of mathematics" by Professor S. C. Davisson, Indiana University, by invitation.

2. "What about mathematics in the junior high school? One answer" by Vivian R. Ely, George Washington High School, introduced by Professor Mason.

3. "Mathematics as a personal experience" by Professor P. P. Boyd, University of Kentucky, by invitation.

4. "Problems in the training of teachers of mathematics" by Professor L. H. Whitcraft, Ball State Teachers College, introduced by Professor Mason.

5. "Early Indiana mathematics and mathematicians" by Professor W. E. Edington, DePauw University.

Abstracts of the papers follow.

1. Professor Davisson discussed the changes that have taken place in the teaching of mathematics at Indiana University during the past 44 years. He was one of four mathematics majors in the first class to graduate after the adoption of the plan to require students to major in some chosen field. He discussed important contributions of various mathematicians to the development of mathematics in Indiana.

2. Miss Ely gave a brief sketch of the junior high school movement in the Indianapolis Public Schools with a detailed description of the new course of study recently written for the course in general mathematics. She concluded with some comments on the success of the venture and suggestions for future procedure.

3. Dean Boyd mentioned some of the current misunderstandings concerning the nature and usefulness of the mathematician's work. He pointed out the advantages that the mathematical thinker possesses in dealing with public questions because of his loyalty to ideals of accuracy and logical procedure, but warned against the dangers of intolerance and egotism and of failure to "dress up" his social and political argument so as to appeal to the emotion and the will. An attempt was then made to bring out the contributions of mathematical study to one's personal enrichment through understanding of the world and human life and through the "elevation and composed delight" that reward the devotee.

4. Professor Whitcraft discussed three problems which confront teacher training institutions, namely, (1) who should be admitted to teacher training and the method of selecting those to be admitted; (2) the selection of the curriculum which will be of greatest value to the teacher; and (3) the placement in a teaching position of the individual who has completed his training.

5. Professor Edington traced the development of mathematics in Indiana during the nineteenth century. Indiana University, Hanover College, Wabash College, Franklin College, and DePauw University were all founded between 1820 and 1840, the latter four being strictly sectarian in organization and intent at the time of their founding. The presidents and many of the professors of all five institutions were for many years preachers, the work offered was classical, and the mathematics offered was most elementary since there were no high schools and few academies to prepare students for college. However, fluxions or calculus was offered before 1850, but the number of students taking such work was small, and, as in the east, mathematics was taught as a preparation for astronomy. In 1856 a scientific course of three years in which mathematics was stressed was organized at Indiana University, but it was 1868 before this became a standard four year course and the formal choice of a major subject was not declared until 1887. The first Master's degree with mathematics as the major subject was given at Indiana University in 1888 and the first Ph.D. with

mathematics as the major was given in 1912. The development in the other colleges was parallel to that of Indiana University.

P. D. EDWARDS, *Secretary*

THE MAY MEETING OF THE ALLEGHENY MOUNTAIN SECTION

The fourth regular meeting of the Allegheny Mountain Section was held at Bethany College, Bethany, West Virginia, on Saturday, May 4, 1935. Sessions were held at 10:30 and at 1:30, with a luncheon at 12:45. Professor C. S. Atchison, chairman of the Section, presided at both sessions. Following the afternoon meeting those in attendance were entertained at a very delightful tea as guests of Bethany College.

Sixty-seven representatives of twenty-one educational institutions and research laboratories attended the meetings, including the following twenty-four members of the Association: C. S. Atchison, L. C. Bagby, O. F. H. Bert, Helen Calkins, W. E. Cleland, Elizabeth B. Cowley, L. L. Dines, N. C. Grimes, E. E. Hess, H. C. Hicks, B. P. Hoover, W. W. McCormick, W. I. Miller, T. W. Moore, L. T. Moston, J. H. Neelley, E. G. Olds, J. B. Rosenbach, E. A. Saibel, C. S. Shively, J. C. Stayer, J. S. Taylor, R. W. Thomas, E. A. Whitman; and two institutional member representatives, H. L. Black and W. H. Cramblet.

The fall meeting was set for Saturday, October 26, 1935, at Geneva College, Beaver Falls, Pennsylvania.

The following seven papers were read:

1. "Secondary mathematics on the college level" by President W. H. Cramblet, Bethany College.
 2. "The problem of Chasles for $n=4$ " by Professor W. A. Hallam, West Virginia Wesleyan College, introduced by Professor Atchison.
 3. "An old Euclid of 1537" by Professor O. F. H. Bert, Washington and Jefferson College.
 4. "Some implicit functional theorems" by Professor Helen Calkins, Pennsylvania College for Women.
 5. "From the simple to the involved and back again" by A. M. Dudley, Westinghouse Electric and Manufacturing Company, introduced by the Secretary.
 6. "Some examples from operational calculus" by Professor M. M. Culver, University of Pittsburgh, introduced by the Secretary.
 7. "Seventeenth century calculus" by Professor E. A. Whitman, Carnegie Institute of Technology.
- Abstracts of the papers follow, the numbers corresponding to the numbers in the list of titles.
1. Following a cordial welcome to Bethany College, President Cramblet presented many reasons supporting the opinion that college work in mathematics should be made available to a selected group of graduates from approved high



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The Thirteenth Meeting of the Indiana Section

P. D. Edwards (Secretary)

To cite this article: P. D. Edwards (Secretary) (1936) The Thirteenth Meeting of the Indiana Section, *The American Mathematical Monthly*, 43:9, 523-526, DOI: [10.1080/00029890.1936.11987890](https://doi.org/10.1080/00029890.1936.11987890)

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The Trustees voted to accept the invitation of the Pennsylvania State College to meet there in September 1937.

The Trustees approved the organization of a Southwestern Section of the Association and the By-Laws submitted by the temporary officers. The membership of the Section is to comprise the members of the Association resident in Arizona and New Mexico; in addition individual members resident in areas immediately adjacent to these states may affiliate as individual members.

Informal reports were given by the President and the Secretary on current activities not ready for formal reports.

W. D. CAIRNS, *Secretary-Treasurer*

THE THIRTEENTH MEETING OF THE INDIANA SECTION

The thirteenth annual meeting of the Indiana Section of the Mathematical Association of America was held Friday and Saturday, May 1 and 2, 1936, at Manchester College, North Manchester, Indiana.

Approximately two hundred attended the public lecture on Friday evening and forty registered at the sessions on Saturday, including the following twenty-three members of the Association: W. C. Arnold, J. H. Butchart, H. T. Davis, J. E. Dotterer, W. E. Edington, P. D. Edwards, C. H. Frick, G. H. Graves, H. E. H. Greenleaf, F. H. Hodge, Florence Long, Juna M. Lutz, T. E. Mason, H. A. Meyer, F. R. Moulton, Mary S. Paxton, D. H. Porter, J. A. Reising, C. K. Robbins, L. S. Shively, W. O. Shriner, Anna K. Suter, K. P. Williams.

At the business session on Saturday the following officers were elected for next year: Chairman, W. E. Edington, DePauw University; Vice-Chairman, W. O. Shriner, Indiana State Teachers College; Secretary, P. D. Edwards, Ball State Teachers College. The fourteenth annual meeting will be held at DePauw University, Greencastle, Indiana, in May 1937.

Professor K. P. Williams made a report for the committee appointed to en-

courage and recognize superior preparation for the teaching of secondary mathematics. On the basis of an examination conducted April 18, 1936, a Certificate of Merit was awarded by the Indiana Section to each of three students who completed their requirements this year.

Following the annual dinner on Friday evening the members of the Association were guests at a public lecture in the college chapel. Dr. Moulton, director of the Utilities Power and Light Corporation of Chicago, gave an illustrated lecture on astronomy.

At the sessions on Saturday the following program was presented.

1. "Some examples in mathematics" by Professor H. A. Meyer, Hanover College, retiring chairman.
2. "Mathematics and social phenomena" by Professor H. T. Davis, Indiana University.
3. "An investigation of attitudes of high school students toward mathematics" by Helen Darley, Manchester College, introduced by Professor J. E. Dotterer.
4. "Arithmetic three hundred years ago and now" by Professor T. E. Mason, Purdue University.
5. "Mascheroni's *Geometry of the Compasses*" by Professor L. S. Shively, Ball State Teachers College.
6. "Note on Bieberbach's trisection of an angle" by E. L. Godfrey, Indiana University, introduced by Professor K. P. Williams.
7. "A simple recursion method for solving a system of linear equations" by Professor Cornelius Lanczos, Purdue University, introduced by Professor C. K. Robbins.
8. "Synthetic treatment of cycloids" by Professor J. H. Butchart, Butler University.
9. "A system of equations connected with a comet orbit" by Professor K. P. Williams, Indiana University.
10. "A problem in infinite quadratic forms" by R. L. Deputy, Indiana University, introduced by Professor H. T. Davis.

Abstracts of the papers follow:

1. Professor Meyer discussed some examples from various fields of mathematics which have been constructed to correct certain fallacies of current thinking.
2. In this paper, Professor Davis discussed the general problems of econometrics. and indicated the type of mathematical disciplines most useful in the study of mathematical economics. The paper concluded with a discussion of the problems presented by economic time series. The speaker used lantern slides in the presentation of his paper.
3. Miss Darley recently completed an investigation concerning the attitudes of high-school students toward mathematics. This investigation was conducted by the use of questionnaires which were filled out by 1000 students from four high schools. The conclusions arrived at from these questionnaires included

the fact that 59% of the students do like mathematics. With regard to mathematical magazines and articles, it was found that only 19% of the students had been reading them, the majority of the remainder not being aware of their existence. Some of the suggestions of the students were that the teacher should be better prepared in the subject matter; that the teacher should be more interested and enthusiastic about the subject; and that the classroom work should be varied by the teacher's reading articles concerning the origin and history of mathematics.

4. Professor Mason compared and contrasted, as to contents and methods of presentation, four arithmetics printed in the years 1585, 1631, 1880 and 1925, respectively.

5. Mascheroni published in 1797 his *Geometry of the Compasses* in which he showed the possibilities of compasses alone as an instrument for making geometrical constructions. By means of three "fixed compasses" whose radii are 1, $\sqrt{3}$ and $\sqrt{2}$, he showed how to divide a circle into 2, 3, 4, 6, 8, 12 and 24 equal parts. By the use of two additional fixed compasses the division into 5, 10, 15, 20, 48 and 120 equal parts can be made. Constructions with compasses only were also given for the bisection of an arc, the fourth proportional to three given lines, the intersection of two given lines and of a given line with a given circle. Upon these fundamental constructions rests a proof that any construction which may be made with the ruler and compasses, may be made with the compasses alone. In this paper Professor Shively exhibited these constructions.

6. Mr. Godfrey presented a simple way of showing the connection between the limaçon and Bieberbach's method for trisecting an angle. An exposition of this method was published in *Scripta Mathematica*, vol. 3, 1935, page 326.

7. A new recursion method for the solution of systems of linear equations was discussed by Professor Lanczos. The method of determinants for the solution of linear equations is only of theoretical interest if the number of equations is large. The customary elimination method which reduces successively the order of the system from n to $n-1$, and so on, involves laborious calculations. The method presented builds up a transformation matrix, the elements of which are obtained by successive recursions from the matrix elements of the given system. With the help of this matrix the solution of the system can be obtained by successive recursions. The resulting scheme is analogous to the scheme of the elimination method but the result is obtained in a different sequence and by a much smaller number of operations.

8. Properties of the cycloid, epicycloid and hypocycloid are easily obtained by a purely geometrical treatment. The evolute is generated by a rolling circle homothetic to that which generates the primary curve with respect to the center of the given fixed circle. Professor Butchart obtained relations between the generating circles which lead to expressions for the length of arc of the curve and the area between the curve and the fixed circle.

9. In this paper Professor Williams dealt with the peculiarities of the equations that concern the distance of Encke's comet during its appearance in 1931.

10. Mr. Deputy gave a short treatment of a problem of Hilbert in infinite quadratic forms, approaching it through direct analysis by a new and distinct method. He obtained a solution for a form having a continuous spectrum by the use of the reciprocal of the characteristic matrix of the form.

P. D. EDWARDS, *Secretary*

THE MAY MEETING OF THE ILLINOIS SECTION

The Seventeenth Annual Meeting of the Illinois Section of the Mathematical Association of America was held Friday and Saturday, May 8 and 9, 1936, at Illinois State Normal University, Normal, Illinois.

A total of fifty-three persons registered from fifteen colleges and eleven high schools including the following twenty-six members of the Association: Edith I. Atkin, O. K. Bower, Laura E. Christman, C. E. Comstock, J. J. Corliss, H. B. Curtis, D. R. Curtiss, W. M. Davis, Sister Mariola Dobbin, Elinor B. Flagg, R. E. Gadske, A. E. Gault, R. M. Ginnings, M. C. Hartley, Mildred Hunt, E. C. Kiefer, W. C. Krathwohl, A. H. Larsen, J. R. Mayor, H. J. Miles, E. B. Miller, C. N. Mills, G. E. Moore, H. A. Simmons, Norma K. Stelford, E. H. Taylor.

Professor E. C. Kiefer of James Millikin University had charge of the arrangement of the program and presided at the meetings.

At the business session the following officers were elected for next year: C. N. Mills, Illinois State Normal University, Chairman; W. B. Storm, State Teachers College, De Kalb, Vice-Chairman; and Edith I. Atkin, Illinois State Normal University, Secretary-Treasurer. It was decided to hold the next meeting at De Kalb.

An important item of business was the passing of the following resolution submitted by W. C. Krathwohl, E. H. Taylor and H. B. Curtis:

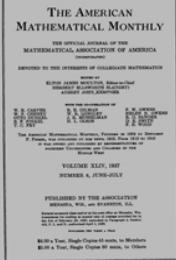
Whereas, the report of the National Committee on the Reorganization of Mathematics in Secondary Education has been of such great value in improving the curriculum and the instruction in secondary mathematics, and

Whereas, there exists a need for a similar report on mathematics in the elementary schools by persons competent to conduct such an investigation, therefore be it

Resolved, that the Illinois Section of the Mathematical Association of America urge the Mathematical Association of America to join with the National Council of Teachers of Mathematics in an effort to obtain the appointment of a national commission on mathematics in the elementary schools and to obtain means for its financial support.

It was voted to ask the secretary to send letters to two beloved members who are suffering from prolonged illnesses: Professor H. E. Slaught of the University of Chicago, and Professor E. B. Lytle of the University of Illinois.

At the dinner held in Fell Hall the guests were welcomed by President Fair-



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

Fourteenth Annual Meeting of the Indiana Section

P. D. Edwards (Secretary)

To cite this article: P. D. Edwards (Secretary) (1937) Fourteenth Annual Meeting of the Indiana Section, *The American Mathematical Monthly*, 44:6, 348-351, DOI: [10.1080/00029890.1937.11987990](https://doi.org/10.1080/00029890.1937.11987990)

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FOURTEENTH ANNUAL MEETING OF THE INDIANA SECTION

The fourteenth meeting of the Indiana Section of the Mathematical Association of America was held Friday and Saturday, April 30 and May 1, 1937, at DePauw University, Greencastle, Indiana.

Eighty persons registered at the different sessions including the following twenty-eight members of the Association: W. C. Arnold, L. G. Black, G. E. Carscallen, J. E. Dotterer, Olive M. Draper, W. E. Edington, P. D. Edwards, G. H. Graves, H. E. H. Greenleaf, S. G. Hacker, Lawrence Hadley, C. T. Hazard, F. H. Hodge, L. P. Hutchison, M. W. Keller, Mayme I. Logsdon, Florence Long, Juna M. Lutz, T. E. Mason, H. A. Meyer, D. H. Porter, H. R. Pyle, C. K. Robbins, C. G. Schilling, L. S. Shively, W. O. Shriner, Anna K. Suter, K. P. Williams.

At the business session on Saturday the following officers were elected for next year: Chairman, W. O. Shriner, Indiana State Teachers College; Vice-Chairman, Florence Long, Earlham College; Secretary, P. D. Edwards, Ball State Teachers College. The fifteenth annual meeting will be held at Indiana State Teachers College, Terre Haute, in May 1938.

Professor P. D. Edwards made the report for the committee appointed to encourage and recognize superior preparation for the teaching of secondary mathematics. On the basis of examinations conducted April 17 and April 24, 1937, a Certificate of Merit was awarded by the Indiana Section to Eugene Grenling of Butler University and Eugene Brazier of Earlham College.

Following the annual dinner on Friday evening the members of the Association met with the members of the Indiana Philosophical Association where the following joint program was presented:

1. "The logical structure of a four-dimensional space" by Professor Mayme I. Logsdon, University of Chicago.
2. "Mathematics and empirical science" by Professor Rudolf Carnap, University of Chicago.

Abstracts of these papers follow:

1. Preliminary to the discussion of the logical structure of a four-dimensional space Professor Logsdon compared the logical structure of Euclid's axiomatic geometry of three-space with the logical structure of an analytical geometry of three-space. The latter is a purely arithmetical theory and is logically equivalent to the former if suitable definitions of the distance function and of the sub-spaces are agreed upon. A space is curved if the angle sum of a triangle whose sides are geodesics is not 180° . A definition was given of a general analytical space, and it was observed that phenomena of our world of experience can be explained by more than one theory, and that it is unwise to accept the predictions of any mathematical theory with regard to situations which cannot be checked by observation.

2. Professor Carnap presented the view that theorems of mathematics sometimes have the same grammatical form as sentences with factual content

(e.g., "7 is a prime number," like "Chicago is a large city"). However, their truth—like that of the theorems of logic—does not depend upon the existence of any facts but upon our conventions as to the structure of language. Within the whole of scientific language, mathematical symbols (e.g., '1', '2', '+', '=', etc.) play the same role as logical symbols (e.g., 'or', 'and', 'not', 'every', etc.); they do not refer to anything but serve to connect other symbols. The chief part of the scientific language consists of the synthetic, factual, sentences of empirical sciences. The theorems of mathematics and logic are instruments for facilitating the operations with such factual sentences.

At the sessions on Saturday the following program was presented:

1. "Vitalizing mathematics" by Professor W. E. Edington, DePauw University, retiring chairman of the Indiana Section.
2. "A class in Fluxions" by Professor H. E. H. Greenleaf and members of the Napierian Club, DePauw University.
3. "A new polynomial approximation for the Gamma Function" by Professor Cornelius Lanczos, Indiana University, introduced by Professor K. P. Williams.
4. "A problem in phase rule" by Zenon Szatrowski, Indiana University, introduced by Professor K. P. Williams.
5. "Homogeneous functionals and Euler's theorem" by Dr. Richard Duffin, Purdue University, introduced by Professor T. E. Mason.
6. "On the derivatives of polynomials" by Dr. A. C. Schaeffer, Purdue University, introduced by Professor T. E. Mason.
7. "What do students think of mathematics?" by Professor G. H. Graves, Purdue University.
8. "Mathematical prefaces and advertisements" by Professor T. E. Mason, Purdue University.

Abstracts of the papers follow, the numbers corresponding to the numbers in the list of titles.

1. Professor Edington presented the following five suggestions as possible means for improving the teaching of mathematics and counteracting the trend away from mathematics: (1) Conscious, continual and consistent reference to the analogies between mathematical processes and the ordinary processes met with in the work-a-day world; (2) Dissemination of information on the wide application of mathematics in the various fields of human endeavor, including not only the fields of physical science, engineering and business, but also such fields as agriculture, physiology, medicine and psychology; (3) Dissemination of knowledge of the parallel cultural development of mathematics with art, literature, and science; (4) Teaching of certain fundamental concepts of mathematics earlier in the student's training; (5) The use of favorable propaganda based on facts and on the opinions of authorities and others who have recognized the values of mathematics as a cultural as well as a utilitarian subject.

2. Professor Greenleaf and four members of the Napierian Club of DePauw University demonstrated the notation and language of Newton by conducting a class recitation using as a text "Principles of Fluxions" by Rev. S. Vince. This text was printed in America in 1812. Most of the demonstrations were in the form of Euclidean algorithms. This form of demonstration appears much more strange today than the difference in notation and raises the interesting question as to whether we profit by the retention of this form in the study of elementary geometry in the United States long after we have abandoned it in all other branches of mathematics and after its abandonment in the study of elementary geometry in the continental countries of Europe.

3. Professor Lanczos discussed a method by which the ordinary asymptotic series of Stirling in the expansion of the Gamma function may be replaced by a strictly convergent series representing the function with even accuracy in a large, finite, a priori given range. The expansion is arranged in Tchebychef's polynomials and yields for the logarithm of $\Gamma(x)$ in the range $1 \leq x \leq \infty$ the successive accuracies $10^{-4}, 10^{-5}, 4 \cdot 10^{-7}, 10^{-10}$ by using two, three, four and eight terms of the series. The coefficients of the approximation have been determined by the method of trigonometric interpolation, making use of the tabulated values of $\log \Gamma(x)$ at 12 selected points of the interval. The same series remains an effective approximation in large portions of the complex domain.

4. The problem discussed by Mr. Szatrowski is to find the composition of the vapor given off by a perfectly miscible binary liquid mixture. It was shown that the composition of vapor in equilibrium with a liquid mixture can be expressed as a function of (1) the composition of the liquid, (2) the composition of an amount of vapor given off during a definite change in the boiling temperatures, and (3) the rates of change of these compositions with the temperature. The composition of the vapor in equilibrium with the liquid mixture is determined by means of this relationship, where the composition of the liquid mixture and the composition of an amount of vapor formed during a definite change in the boiling temperatures have been determined experimentally.

5. Dr. Duffin spoke on the extension of Euler's Theorem to "homogeneous functionals." Suppose the product of two functions is integrated over a fixed region. If one of the functions is homogeneous, it may be replaced by Euler's well known expressions, but this replacement might be valid in some cases even if the function were not homogeneous. A modified definition of homogeneous was given which is a sufficient condition for this replacement. An application was given to potential theory.

6. Dr. Schaeffer acknowledged credit to Dr. Duffin for assistance in the preparation of this paper. Let $P(z)$ be a polynomial of degree n with real coefficients and not greater than 1 in absolute magnitude in the interval $(-1, 1)$ of the real axis. The n th Tchebychef Polynomial, $T_n(z) \equiv \cos(n \cos^{-1}z)$, satisfies these conditions. It is shown that at certain points inside the unit circle of the z plane and at all points outside the unit circle $|P^k(z)| \leq |T_n^k(z)|$, superscripts denoting differentiation.

7. During three years twenty-one classes of students were asked, "What, in your opinion, are the values in studying mathematics?" The students were predominantly freshman and sophomore engineers, but there were two classes of science freshmen and three classes included juniors and seniors expecting to teach mathematics. Professor Graves stated there was much evidence that students were seeking to relate their study of mathematics to their total experience. Besides the predominant reply that mathematics is needed in engineering and science many emphasized that the procedure of solving a problem was of value in a wide range of situations. Most students seem to assume the transfer of training but some appreciate that the problem of transfer demands special attention.

8. Professor Mason discussed the changes that took place in the purposes of authors in writing mathematical books as illustrated by the prefaces in forty books distributed over the period from 1585 to 1859. Extracts from prefaces were quoted as illustrative of authors' purposes. He illustrated also the nature of advertisements printed in mathematical books during this period.

P. D. EDWARDS, *Secretary*

THE MAY MEETING OF THE ALLEGHENY MOUNTAIN SECTION

The eighth regular meeting of the Allegheny Mountain Section of the Mathematical Association of America was held at Waynesburg College, Waynesburg, Pennsylvania, on Saturday, May 1, 1937. Professor L. L. Dines, chairman of the Section, presided at both the morning and afternoon sessions. Following the afternoon session a very enjoyable social hour was spent at a tea arranged through the courtesy of the Waynesburg College department of mathematics. The date of the fall meeting was set for October 23, 1937, at the University of Pittsburgh.

The number of those in attendance was fifty-one, including the following twenty-seven members of the Association: C. S. Atchison, O. F. H. Bert, H. L. Black, A. M. Bryson, Helen Calkins, L. L. Dines, H. L. Dorwart, F. A. Foraker, C. H. Graves, R. P. Johnson, V. V. Johnston, A. V. Karpov, W. A. Klein, M. L. Manning, David Moskovitz, L. T. Moston, E. G. Olds, F. W. Owens, Helen B. Owens, J. B. Rosenbach, E. A. Saibel, S. R. Smith, E. M. Starr, R. G. Sturm, J. S. Taylor, Bird M. Turner, E. A. Whitman.

Following a welcoming address by President P. R. Stewart of Waynesburg College, the following five papers were read:

1. "Purposive selection" by W. A. Klein, Carnegie Institute of Technology.
2. "A theorem concerning certain surface paths on the rectangular parallelopiped" by V. V. Johnston, National Tube Company.
3. "Elementary electrodynamics of the cathode ray oscillograph" by E. R. Whitehead, Duquesne Light Company, introduced by the Secretary.



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

Section Meetings

J. S. Taylor (Secretary), J. S. Taylor (Secretary) & P. D. Edwards (Secretary)

To cite this article: J. S. Taylor (Secretary), J. S. Taylor (Secretary) & P. D. Edwards (Secretary) (1938) Section Meetings, *The American Mathematical Monthly*, 45:8, 493-499, DOI: [10.1080/00029890.1938.11990844](https://doi.org/10.1080/00029890.1938.11990844)

To link to this article: <https://doi.org/10.1080/00029890.1938.11990844>



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PROPOSED AMENDMENT TO THE BY-LAWS OF THE ASSOCIATION

The experience of the Mathematical Association is that the life membership fee has not in recent years been in accordance with actuarial practice. The Trustees have therefore authorized the Secretary-Treasurer to propose the following amendment to Article VII of the By-Laws, the amendment to be presented for adoption at the Annual Meeting in December 1938. In the meantime life membership fees will not be accepted on the old basis.

Section 6, Article VII shall read:

The life membership fee shall be the present value, according to the American Annuitants' Table (Male) based upon three and one-half ($3\frac{1}{2}$) per cent interest, of an annuity due of Four Dollars (\$4) a year at the attained age of the member; an annual valuation of the life membership fund shall be made under the American Annuitants' Table (Male), three and one-half ($3\frac{1}{2}$) per cent; and the reserve thus computed shall be held as a liability.

W. D. CAIRNS, *Secretary-Treasurer*

THE OCTOBER MEETING OF THE ALLEGHENY MOUNTAIN SECTION

The ninth regular meeting of the Allegheny Mountain Section of the Mathematical Association of America was held at the University of Pittsburgh, Pittsburgh, Pennsylvania, on Saturday, October 23, 1937. Professor L. L. Dines, chairman of the Section, presided at both the morning and afternoon sessions.

Forty-six representatives from twelve colleges, three research laboratories, and twelve high schools attended the meeting, including the following twenty-four members of the Association: O. F. H. Bert, H. L. Black, A. M. Bryson, Helen Calkins, W. E. Cleland, Elizabeth B. Cowley, L. L. Dines, H. L. Dorwart, F. A. Foraker, H. C. Hicks, B. P. Hoover, R. P. Johnson, V. V. Johnston, H. R. Leifer, M. L. Manning, L. T. Moston, J. H. Neelley, E. G. Olds, J. B. Rosenbach, E. M. Starr, J. S. Taylor, R. W. Thomas, W. J. Wagner, E. D. Wells.

At the annual business meeting the following officers of the Section were elected: Chairman, H. L. Black, Westminster College; Secretary-Treasurer, J. S. Taylor, University of Pittsburgh; Member of the Executive Committee, H. C. Hicks, Carnegie Institute of Technology. Professor F. W. Owens, Pennsylvania State College, continues in office for the second year of his term as the additional member of the executive committee.

The following five papers were read:

1. "A problem in heat conduction with application to the ignition of gases" by H. G. Landau, Coal Research Laboratory, Carnegie Institute of Technology, introduced by the Secretary.
2. "Mathematics for the millions" by Professor W. P. Cunningham, California State Teachers College, introduced by C. S. Atchison.
3. "The Tarry-Escott problem" by Professor H. L. Dorwart, Washington and Jefferson College.

4. "An application of the derivative for classes in elementary calculus" by A. M. Bryson, University of Pittsburgh.

5. "Cryptography" by Professor H. C. Hicks, Carnegie Institute of Technology.

Abstracts of these papers follow, with the numbers corresponding to the numbers in the list of titles:

1. Mr. Landau's problem arose from a consideration of the processes which occur when a mixture of combustible gases is ignited by a local source, such as an electric spark. A heat conducting medium of infinite extent is initially at temperature T_0 , except within a sphere of radius R , where the initial temperature is T_1 . At the start this sphere is filled with active particles which diffuse through the medium; each active particle generates Q units of heat in unit time and they increase in number at a rate proportional to their concentration. It is desired to determine the condition for the temperature at the center of the sphere never to decrease. The partial differential equations for concentration of active particles and temperature are solved and from this the required condition is obtained.

2. A recent study made by the Committee for Curriculum Revision in the State Teachers Colleges of Pennsylvania revealed that the current practice of colleges is to minister chiefly to the needs of mathematics majors, with little or no provision for others. To meet this situation Professor Cunningham suggested that college teachers enrich their courses by introducing more of the applications of mathematics to science, industry, and the study of social phenomena.

3. This is a report of a portion of a joint paper of the same title by H. L. Dorwart and O. E. Brown which appeared in this MONTHLY, December 1937, pages 613-626.

4. Mr. Bryson developed a method suitable for classes in elementary calculus whereby approximate values of the elementary transcendental functions may be obtained to any desired accuracy from a known initial value of such a function and a knowledge of its derivatives. Not only does this treatment throw early illumination on the rôle and significance of the derivative, but by passing to the limit an opportunity is offered to introduce Taylor's series in a somewhat novel but straightforward manner.

5. In discussing code making and code deciphering Professor Hicks explained the nature of the different types of codes employed and methods of deciphering and presented many illustrations of historical interest. In particular he emphasized the practical feature that a code should be simple enough to permit its easy use without being decipherable quickly enough to destroy the purpose for which it was designed. In conclusion, Professor Hicks challenged the ingenuity of the audience in deciphering a code message appropriate to the meeting, which was based upon the key "The Mathematical Association of America."

J. S. TAYLOR, *Secretary*

THE MAY MEETING OF THE ALLEGHENY MOUNTAIN SECTION

The tenth regular meeting of the Allegheny Mountain Section of the Mathematical Association of America was held at the Sharon Works of the Westinghouse Electric and Manufacturing Company, Sharon, Pennsylvania, on Saturday, May 14, 1938. Professor H. L. Black, chairman of the Section, presided at both the morning and afternoon sessions, which were held in the auditorium of the new research building of the Sharon Works. The last paper on the program included a demonstration in the special laboratory for the production of artificial lightning.

The meeting was attended by sixty-eight representatives from eleven colleges, ten research laboratories and industrial concerns, and two high schools, including the following seventeen members of the Association: C. S. Atchison, H. L. Black, Helen Calkins, W. E. Cleland, L. L. Dines, H. L. Dorwart, C. W. Foard, B. P. Hoover, V. V. Johnston, A. V. Karpov, M. L. Manning, L. T. Moston, C. T. Oergel, E. G. Olds, J. S. Taylor, W. J. Wagner, E. D. Wells.

Following a welcoming address by W. M. Dann, assistant manager, Transformer Engineering Department, Westinghouse Electric and Manufacturing Company, the following five papers were read:

1. "Scientific approach to engineering problems" by A. V. Karpov, chairman of Committee on Fundamentals Controlling Structural Design, American Society of Civil Engineers; Consulting Engineer, Pittsburgh.
2. "The content of a course in higher algebra for prospective secondary school teachers of mathematics" by Professor W. H. Erskine, Bethany College, introduced by the Secretary. Leader of discussion: Professor E. G. Olds, Carnegie Institute of Technology.
3. "Use of mathematics in engineering" by H. V. Putman, manager, Transformer Engineering Department, Westinghouse Electric and Manufacturing Company, introduced by Mr. Manning.
4. "Analysis of transient voltages in transformer networks" by P. L. Bellaschi and A. J. Palermo, Westinghouse Electric and Manufacturing Company, introduced by Mr. Manning.
5. "Demonstration of laboratory lightning" by M. L. Manning, Westinghouse Electric and Manufacturing Company.

Abstracts of these papers follow, with the numbers corresponding to the list of titles:

1. Mr. Karpov outlined in a comprehensive fashion the similarity in the present day developments of the fine arts, science, and engineering. The method of carrying human knowledge beyond the perceptual world by the introduction of a conceptual world was discussed and illustrated by significant examples in these fields. The mathematical bases of the exact sciences were outlined, as well as their application to engineering problems. Particular attention was given to the concept of stress, its limitations, and the necessity of extending this concept.

2. Professor Erskine gave a description of the aims, content, and methods of a course in higher algebra given at Bethany College during the current year for

prospective secondary school teachers of mathematics. The aims were to widen the high school teacher's interest in and appreciation of the subject matter of algebra and arithmetic. The content included topics from the theory of integers and the fundamental concepts of algebra and arithmetic; the method involved lectures, assigned readings, and exercises showing the dependence of algebra and arithmetic upon fundamental concepts, and included the experimental contact with algebras differing from that taught in high schools. The discussion, led by Professor Olds, brought out many other features of general interest.

3. Mr. Putman thought it might be possible in mathematics classes for engineering students to place greater emphasis on the application of mathematics than on manipulative technique. Comparatively few engineers attain great proficiency in the real use of mathematics, and much of what is learned is forgotten because of inability to apply it. It was even suggested that for students who do not go to college it might be possible to develop a high school course in elementary calculus and linear differential equations which would be less difficult than some parts of intermediate algebra and much more useful. A summary of mathematical applications in transformer design was included to show the importance of a thorough training in mathematics in this branch of engineering. In response to the suggestion that an endeavor be made to evaluate the usefulness of different branches of mathematics in engineering fields in order that students may select those courses likely to be of greatest value to them, a motion was passed that the Society for the Promotion of Engineering Education be informed of the interest that would attach to such a study.

4. This investigation by Mr. Bellaschi and Mr. Palermo was a study, both from an engineering and a mathematical analysis viewpoint, of transformer networks subjected to lightning. The solution for the response of the network showed completely the amplitudes and periods of natural oscillations. A geometric method of approach aids materially the analytic work. The mathematical analysis formulated a complete system of solutions for obtaining the network responses. A pattern of "alpha" operators was developed which reduced the work to relatively simple algebra. To form this pattern, only the operational solutions for one and two mesh networks were required. From this pattern solutions can be directly written for networks having any specified number of meshes. The analysis was applied to transformer windings and is applicable to many fields of electrical engineering.

5. Following a description of the laboratory equipment by Mr. Manning, the most important of which are the high voltage generator (3,000,000 volts) and a heavy current generator (150,000 amperes), a very spectacular demonstration was given. A wood pole used for distribution service was badly splintered when subjected to a discharge from the generator. A similar lightning stroke was then applied to a distribution transformer protected by deion gaps; the transformer was unharmed. The paper concluded with a discussion of the many developments which lightning stroke generators may aid in producing.

J. S. TAYLOR, *Secretary*

FIFTEENTH ANNUAL MEETING OF THE INDIANA SECTION

The fifteenth annual meeting of the Indiana Section of the Mathematical Association of America was held Friday and Saturday, May 6 and 7, 1938, at Indiana State Teachers College, Terre Haute, Indiana.

Eighty-one registered at the meetings including the following twenty-three members of the Association: W. C. Arnold, Juna Lutz Beal, C. S. Doan, J. E. Dotterer, Olive M. Draper, W. E. Edington, P. D. Edwards, Louis Green, H. E. H. Greenleaf, W. R. Hardman, L. C. Karpinski, M. W. Keller, Cornelius Lanczos, Florence Long, T. E. Mason, Karl Menger, H. A. Meyer, H. R. Pyle, C. K. Robbins, L. S. Shively, W. O. Shriner, L. H. Whitcraft, K. P. Williams.

At the business session on Saturday the following officers were elected for next year: Chairman, C. K. Robbins, Purdue University; Vice-Chairman, L. S. Shively, Ball State Teachers College; Secretary, P. D. Edwards, Ball State Teachers College. The sixteenth annual meeting will be held at Ball State Teachers College on April 28 and 29, 1939.

Professor K. P. Williams of Indiana University made the report for the committee appointed to encourage and recognize superior preparation for the teaching of secondary mathematics. On the basis of examinations conducted April 23 and April 30 a Certificate of Merit in Mathematical Preparation was awarded to Margaret Stump of Butler University.

Following the annual dinner on Friday night the following program was presented:

1. "Report on the work of the Joint Commission of the Association and the National Council on the place of mathematics in the secondary schools" by Professor K. P. Williams, Indiana University.
2. "Report on the study of a committee of the American Association of Teachers Colleges on desirable attainments for teachers of secondary mathematics" by Professor L. H. Whitcraft, Ball State Teachers College, introduced by the Secretary.
3. "The need for greater emphasis on the mathematics of finance" by Professor W. O. Shriner, Indiana State Teachers College.

At the meetings on Saturday the following program was presented:

4. "The three classical problems of geometry" by Professor Karl Menger, University of Notre Dame.
5. "Sources of material which we present in freshman mathematics" by Professor L. C. Karpinski, University of Michigan.
6. "Interpolating and extrapolating power series" by Professor Cornelius Lanczos, Purdue University.
7. "A practical general formula for annuity problems" by Professor H. E. H. Greenleaf, DePauw University.
8. "Concerning a certain functional equation" by Professor K. P. Williams, Indiana University.
9. "Abstract group definition for groups of finite order" by Professor W. E. Edington, DePauw University.

10. "Fractional radices" by Professor H. A. Meyer, Hanover College.
11. "A solution of the quartic equation" by M. E. Gamble, Purdue University, introduced by Professor Robbins.

Abstracts of the papers follow, the numbers corresponding to the numbers in the list of titles:

1. Professor Williams gave a discussion of the work of the Joint Commission of the Mathematical Association of America and the National Council of Teachers of Mathematics, which is studying the place of mathematics in the secondary schools. He commented upon the first four chapters of the Preliminary Report which had already appeared, and gave an outline of the contents of the remaining part, which was to appear about July 1, 1938.

2. Professor Whitcraft gave an account of the method employed to secure a list of desirable attainments for teachers of secondary mathematics. The attainments were classified under the headings: (a) Subject matter, (b) Professional understanding and skills relating to mathematics, and (c) Personal qualifications. The study originated in the Teachers College Conference Group at the University of Chicago, 1937, with fourteen mid-western institutions co-operating.

3. With the mathematics of finance as the central theme, Professor Shriner stated that high school algebra could be made the most vital part of secondary education and an essential part of the general education of every adult. The algebraic principles involved in analyzing problems in home finance, savings, installment buying, amortization, depreciation, insurance, etc., reveal the need for all the topics of elementary algebra.

4. Professor Menger pointed out that the answer to the questions whether one can double the cube, trisect the angle, and square the circle depends, of course, on the means of construction allowed. A conchoidograph allows us to construct exact solutions for the first two. An involutograph, of which simple forms have recently been devised, enables us to construct, from a circle, with radius r , a segment of length πr , and consequently πr^2 . Approximate solutions of great accuracy are possible for all three problems by means of ruler and compasses. Noteworthy among them is a simple trisection of the angle with an inaccuracy of less than $20''$ due to Kopff.

5. The mathematical material presented to freshmen in American colleges is directly connected by Professor Karpinski with the most ancient mathematical documents of the Babylonians and Egyptians. Recent discoveries touch vitally the story of the progress of algebraic and trigonometric ideas. The intensive development of algebra and the applications of its methods to geometry have been extended backwards in time to some two thousand years before the Christian Era. The new problems are concerned primarily with the perimeter and with linear, quadratic, and even cubic functions of the sides of triangles and rectangles. Arithmetical series are involved in the division into trapezoidal areas of triangles and trapezoids. Trigonometric development, notably computation of chords in a circle by the Pythagorean theorem, are now definitely connected

with the highly scientific Babylonian astronomy. The progress of geometrical algebra and trigonometry in Greece, and similar work among the Arabs, is made a natural continuation of the Babylonian ideas. European and modern developments are revealed as vitally bound to the past by the new material. The analytic geometry of Descartes and Fermat is indicated as another phase of the fruitful association of geometry and algebra as begun in Babylon and Egypt and as continued in Greece, India, and the Mohammedan World.

6. The different nature of extrapolating and interpolating series was discussed by Professor Lanczos. The Taylor series and the so-called "asymptotic expansions" illustrate the former, the Fourier series the latter. The Tshebysheff polynomials permit the Fourier series to be transformed into an ordinary power series and thus increase the convergence of both Taylor and asymptotic expansions, by transforming them into interpolating series. For the Taylor series a mere re-arrangement of the series in Tshebysheff's polynomials yields a series which approximates closer in a given range with the same number of terms, for the asymptotic expansions trigonometric interpolation is necessary to obtain an "economized" series. Illustrations were given.

7. Professor Greenleaf presented a simple symbol which has proved useful in teaching the solution of practical problems in annuities. This symbol, used with three simple rules for reducing it to tabulated symbols, helps eliminate many of the errors frequently made.

8. It is well known that if H_n is a spherical harmonic of order n then H_n/r^{n+1} , where $r^2 = x^2 + y^2 + z^2$, is also a solution of the Laplace equation. Professor Williams considered the question of determining m from a functional equation in such a way that H_n/r^m will satisfy the equation of Laplace. The equation arrived at is $f(n) + f(n-f(n)) = 0$. Some of the properties of this equation were noted and different solutions were given. If $g(n) = n - f(n)$, then $g(g(n)) = n$, or $g(n) = g^{-1}(n)$, so that $g(n)$ is its own inverse, and $y = g(x)$ is symmetric with regard to $y = x$.

9. Professor Edington surveyed some of the work that has been done in the definition of finite abstract groups defined by two operators whose product is of the second or third order in which one additional condition is imposed. He stated a number of theorems and relations that are useful in determining the orders of operators. The existence of groups and systems of groups was made to depend on substitutions and the use of mathematical induction.

10. The use of number systems with base other than ten is familiar to mathematicians. Professor Meyer demonstrated the peculiarities of such systems in case the base is a proper fraction.

11. Mr. Gamble gave a general solution of the quartic equation in which he derived the resolvent cubic by a method somewhat more straight-forward than in the solution of Ferrari.

P. D. EDWARDS, *Secretary*

ABC , mid-way between D_h and the orthocenter H_d of the triangle ABC . (4) The centroid of the triangle UD_hH_d coincides with the centroid of ABC . (5) The projection, upon ABC , of the vertex of the twin tetrahedron (T') of (T) which corresponds to D is the diametric opposite of M on the nine-point circle of the triangle ABC .

5. Professor Schorling considered the following topics: (1) The needs of secondary pupils as regards basic skills in mathematics. (2) The contribution of courses in the mathematics of the secondary school to the general reader. (3) The need for mathematics in the introductory courses in science of the secondary school. (4) The basic concepts and principles to be included in mathematics that are to contribute to general education.

J. C. BRIXEY, *Secretary*

SIXTEENTH ANNUAL MEETING OF THE INDIANA SECTION

The sixteenth annual meeting of the Indiana Section of the Mathematical Association of America was held Friday and Saturday, April 28 and 29, 1939, at Ball State Teachers College, Muncie, Indiana.

Seventy-four registered at the meetings including the following twenty-five members of the Association: Emil Artin, Juna Lutz Beal, W. D. Cairns, J. E. Dotterer, Olive M. Draper, P. D. Edwards, W. R. Hardman, Cora B. Hennel, F. H. Hodge, L. P. Hutchison, M. W. Keller, D. A. Lehman, Florence Long, H. A. Meyer, D. H. Porter, H. R. Pyle, C. K. Robbins, L. S. Shively, D. R. Shreve, W. O. Shriner, Anna K. Suter, M. S. Webster, Agnes E. Wells, K. P. Williams, H. E. Wolfe.

At the business session on Saturday morning the following officers were elected for next year: Chairman, L. S. Shively, Ball State Teachers College; Vice-Chairman, Cora B. Hennel, Indiana University; Secretary, P. D. Edwards, Ball State Teachers College. The seventeenth annual meeting will be held at Earlham College, Richmond, Indiana.

Professor K. P. Williams made a report for the committee appointed to encourage and recognize superior preparation for the teaching of mathematics. On the basis of an examination conducted April 23, 1938, and April 22, 1939, a Certificate of Merit in Mathematical Preparation was awarded to Charles F. Brumfield of Ball State Teachers College, and to Richard E. Dietrich of Indiana University.

The annual dinner was held jointly with the Xi chapter of Sigma Zeta Honorary Science and Mathematics Society. Mr. James Findling, President of Xi chapter, served as toastmaster and introduced President L. A. Pittenger of Ball State Teachers College, who welcomed the visitors.

Following the dinner the first session of the Section was held, at which time Professor W. D. Cairns of Oberlin College gave an illustrated lecture on "The rôle of mathematics in seismology." Professor Cairns described the probable cause of earthquakes, the three main types of waves, the mathematical evidence

for their paths through or about the earth, the consequent deductions as to the nature of the earth's interior, including the conclusions as to the discontinuities in the earth's structure. He explained the theory of seismometers. Further topics which involved mathematical treatment were the correspondence between displacements on the instrumental records and displacements of the earth which these records are meant to give, the method of least squares in connection with the travel-time curves, and the consistency of various estimates of the earth's interior.

At the two sessions on Saturday the following program was given:

1. "Problem making" by Professor C. K. Robbins, Purdue University.
2. "Order relation in fields" by Professor Emil Artin, Indiana University.
3. "Some technical aspects of the mathematics of seismology" by Professor W. D. Cairns, Oberlin College.
4. "On the foundations of mathematics" by D. O. Schechter, Manchester College, introduced by Professor Dotterer.
5. "The generalization of the Eckhardt point" by Dr. D. R. Shreve, Purdue University.
6. "The general second degree equation without transformation of coördinates" by Professor K. P. Williams, Indiana University.
7. "A certain Lagrange interpolation formula" by Dr. M. S. Webster, Purdue University.

Abstracts of the papers follow, the numbers corresponding to the numbers in the list of titles:

1. Professor Robbins discussed the matter of the construction of problems which would be suitable for textbook material. Several problems of different types were discussed. Among these was one consisting of two curves, each having rational coefficients so determined that the common tangents to the two curves have rational coefficients and are tangent at points whose coördinates are rational. Other interesting examples were given from the field of differential equations.

2. Hilbert's problem to characterize all geometric construction that can be carried out by means of ruler and compasses only, leads to the question, what elements of a field can be represented as a sum of squares? Professor Artin showed that if the element -1 is the sum of squares of elements of a field, then every element of the field is the sum of squares of elements of the field. So the interesting case is that of a field in which -1 is not a sum of squares. Such a field is called a real field. It can be shown that the real fields are identical with fields in which one can establish an order. An element of a real field is a sum of squares if, and only if, it is positive in whatever way one might order the field.

3. Professor Cairns gave a more technical consideration to those mathematical topics which could not be adequately treated in the general lecture of Friday evening.

4. Mr. Schechter discussed the three schools of thought that have been interested in the investigation of the foundation of mathematics, the formal, the

logical, and the postulational. The program as presented by each school was considered and the three schools were compared as to the actuality of the foundations, subject matter, method and structure, and consistency. From these comparisons, general conclusions were made concerning the nature of mathematics.

5. The generalized Eckhardt point was defined by Dr. Shreve, and two theorems of Eckhardt were given. The multiplicity of the Eckhardt point on the Hessian of the surface was determined; the configuration of Eckhardt points on the Segre Cubic Variety was discussed in detail.

6. The paper of Professor Williams considered the problems involved in the direct reduction of the equation

$$Ax^2 + By^2 + 2Hxy + 2Cx + 2Dy + E = 0$$

to the form

$$(x - \alpha)^2 + (y - \beta)^2 = e^2 \frac{(ax + by + c)^2}{a^2 + b^2}.$$

7. Dr. Webster discussed the Lagrange interpolation polynomial

$$l_k^{(n)}(x) \equiv \phi_n(x)/[(x - x_k)\phi'_n(x_k)],$$

where

$$\phi_n(x) \equiv (x - x_1)(x - x_2) \cdots (x - x_n), \quad x_k = \cos [k\pi/n + 1].$$

He proved that in the interval $(-1, 1)$ the maximum of the absolute value of $l_k^{(n)}(x)$ is less than 2. This is the best possible inequality for all n and k .

P. D. EDWARDS, *Secretary*

THE APRIL MEETING OF THE KANSAS SECTION

The twenty-fifth annual meeting of the Kansas Section of the Mathematical Association of America was held at the High School in Topeka, on Saturday, April 1, 1939. In the morning there was a joint session with the Kansas Association of Teachers of Mathematics, of which most members of the Section are also members. After the social hour and the luncheon, the two organizations met for separate programs. Professor C. B. Tucker, chairman of the Section, presided at the morning session as well as at the Section meeting.

The attendance was one hundred sixty-one, among whom were the following thirty-four members of the Association: Sister Ann Elizabeth, Sister Mary N. Arnoldy, Wealthy Babcock, E. A. Beito, Lois E. Bell, Florence L. Black, E. E. Colyer, R. D. Daugherty, Lucy T. Dougherty, W. H. Garrett, W. A. Harshbarger, A. J. Hoare, Emma Hyde, H. E. Jordan, C. F. Lewis, W. H. Lyons, Anna Marm, U. G. Mitchell, Thirza Mossman, O. J. Peterson, P. S. Pretz, G. B. Price, C. B. Read, B. L. Remick, D. H. Richert, J. A. G. Shirk,

sound wave is the intersection of the two hyperbolas. In actual practice, the hyperbolas are not plotted, but it is assumed that the source of the sound wave lies on the asymptotes. An asymptote correction is applied to compensate for the error of this assumption. A second correction compensates for the varying time of travel of the sound wave due to the velocity and direction of the wind. A third correction compensates for variations in the time of travel of the sound wave due to departure of the temperature of the air from standard. The problem admits of graphical solution, but requires personnel of high intelligence and excellent training.

12. Miss May gave a summary of the developments in aeronautics during the past few years.

13. Professor Swingle made an abstraction of several fundamental definitions of topology, and discussed the possible domain of application.

14. Professor Boldyreff considered the existence and uniqueness of decomposition of a rational fraction into partial fractions, and the explicit formulas for the numerators of the partial fractions for all cases. The numerical properties of the coefficients were investigated in connection with the numerators of partial fractions corresponding to repeated prime quadratic factors.

H. D. LARSEN, *Secretary*

THE EIGHTEENTH ANNUAL MEETING OF THE INDIANA SECTION

The eighteenth annual meeting of the Indiana Section of the Mathematical Association of America was held Friday and Saturday, May 2 and 3, 1941, at Butler University, Indianapolis, Indiana.

Seventy-five registered at the meetings, including the following thirty-five members of the Association: W. C. Arnold, Emil Artin, Max Astrachan, Juna Lutz Beal, I. W. Burr, W. W. Denton, R. H. Downing, W. E. Edington, P. D. Edwards, B. C. Getchell, E. L. Godfrey, G. H. Graves, W. R. Hardman, H. H. Hartzler, Cora B. Hennel, H. K. Hughes, M. W. Keller, W. C. Krathwohl, Cornelius Lanczos, D. A. Lehman, Florence Long, H. A. Meyer, C. N. Moore, P. M. Pepper, J. C. Polley, D. H. Porter, C. K. Robbins, L. S. Shively, D. R. Shreve, W. O. Shriner, Anna K. Suter, M. S. Webster, Agnes E. Wells, F. J. Weyl, H. E. Wolfe.

At the business meeting on Saturday the following officers were elected for next year: Chairman, P. D. Edwards, Ball State Teachers College; Vice-Chairman, J. C. Polley, Wabash College; Secretary, M. W. Keller, Purdue University. On account of the increased number of papers being presented it was voted that the Indiana Section of the Association should hold two meetings per year. The spring meetings will be continued and a second meeting will be held jointly with the Mathematics Section of the Indiana Academy of Science. The first joint meeting with the Indiana Academy will be held at DePauw University in November, 1941.

At the annual dinner on Friday evening Professor Beal of Butler University served as toastmaster and introduced Dr. D. S. Robinson, president of Butler University, who welcomed the visitors. Dr. Robinson paid tribute to the importance of the study of mathematics to the student of philosophy, in which field he achieved national prominence before taking over his duties as president of Butler University.

Following the dinner the first session of the Section was held, at which time Professor C. N. Moore of the University of Cincinnati was guest speaker. His subject was "On the interdependence of pure and applied mathematics." Professor Moore pointed out that the history of mathematics reveals many instances in which the methods needed for the solution of an applied problem had been developed far in advance of the need, in the course of the natural growth of mathematical theory. Likewise, the study of an applied problem has frequently raised questions which stimulated extensive developments in the field of pure mathematics. This mutual relationship between the pure and applied branches of the subject was illustrated by means of various special cases of particular importance.

At the two sessions on Saturday the following program was presented:

1. "And gladly teach" by Professor Cora B. Hennel, Indiana University, retiring chairman of the Indiana Section.
2. "Predicting class quality on the basis of orientation tests" by Professor W. C. Krathwohl, Illinois Institute of Technology, by invitation.
3. "Further findings from the diagnostic testing program" by Dr. M. W. Keller and Dr. D. R. Shreve, Purdue University.
4. "A report of pre-college mathematics by correspondence" by Dr. D. R. Shreve and Dr. M. W. Keller, Purdue University.
5. "The appeal of useful mathematics" by Professor Emeritus D. A. Lehman, Goshen College.
6. "After sectionizing; what?" by Professor Max Astrachan and Professor I. W. Burr, Antioch College.
7. "History of mathematics in Indiana" by Professor W. E. Edington, DePauw University.
8. "Fundamental properties of the Gamma function" by Professor Emil Artin, Indiana University.
9. "The motion of a particle in a Riemannian world" by Professor Cornelius Lanczos, Purdue University.
10. "The value of the p -adic logarithm" by David Gilbarg, Indiana University, introduced by Professor Artin.
11. "A locus related to the Euler line" by K. W. Crain, Purdue University, introduced by Professor Graves.
12. "Value distribution of ring meromorphic functions" by Dr. F. J. Weyl, Indiana University.
13. "Automorphisms of a simple algebra" by Dr. G. W. Whaples, Indiana University, introduced by Professor Artin.

Abstracts of papers follow, the numbers corresponding to the numbers in the list of titles:

1. Professor Hennel discussed the responsibility of mathematics teachers for rendering various types of service. Teachers must serve as investigators, contributing to the development of the subject in its pure and applied phases; as historians, recording and evaluating subject-matter and writing biographies; as teachers, instructing students in the different branches of mathematics; as writers of text-books; and as faculty members, working toward the all-around development of students. Special emphasis was placed on the importance of the work as teacher. Too often promotions in the college field are based on the work in the first two fields with the result that there is neglect of the primary purpose for which the undergraduate school is organized.
2. Professor Krathwohl presented some results of investigations carried out at the Illinois Institute of Technology. At the time of the first meeting, it is possible by means of such tests as the Iowa Placement Mathematics Aptitude Examination and the American Council Psychological Examination to predict the quality of a freshman class in mathematics. Because standards and types of students vary in different colleges, the constants involved in the computation have to be computed separately for each institution. The advantage of such a prediction is that if an instructor has a weak class, he knows he must work much harder on fundamentals. If he has an unusually good class, he can use this fine opportunity to enrich the content of the course.
3. Dr. Keller presented a second progress report on the diagnostic testing program which has been inaugurated at Purdue University. Some of the findings from the results of two years of testing were given. In addition, the ability of students to perform the fundamental operations with exponents and radicals as revealed by the revised tests which were given in 1940-1941 was discussed briefly.
4. Dr. Shreve presented a report on the results of an experimental review course given by correspondence to 230 students planning to enter Purdue University. The study shows (1) an analysis of the types of errors prevalent among entering students, (2) a discussion of the opportunities for remedial work by the university before the student enters, and (3) a report on the noticeable achievements of the course. The study indicates that the university can, by pre-college training, prepare students to compete with superior students with equal success in a single course. Following the study of the results of this course, Purdue University now offers this pre-college course by correspondence as a regular summer project.
5. Professor Lehman discussed a large number of applications of elementary mathematics which are not ordinarily found in elementary texts. These included applications to surveying problems and problems in astronomy, as well as the more familiar problems commonly found in text-books.
6. Professor Astrachan described the Antioch program in mathematics as developed by himself and Professor Burr. There is a horizontal sectionizing on

the basis of high school records and placement tests. Candidates for the Bachelor of Science degree are given the usual training in algebra, trigonometry, analytics, and calculus. Emphasis is primarily on skills and applications. The courses taken by candidates for the Bachelor of Arts degree are planned to be of a more cultural nature. They include, among other things, certain skills useful in many fields and in everyday intelligent living. Advanced courses included some aspects of modern mathematics. Procedure in most courses is on a laboratory basis. Achievement is measured by a system of quizzes which test the mastery of all material as it is covered.

7. Professor Edington discussed the growth of instruction in mathematics in Indiana. The Territory of Indiana was organized in 1800 and the Territorial Legislature, following special action by congress in 1804, passed acts in 1806 and 1807 leading to the incorporation of Vincennes University. These acts required, among other things, the instruction of the youth in mathematics. During the next twenty-five years Indiana University, Hanover, and Wabash Colleges were founded and instruction in algebra, geometry, navigation, and surveying was offered. By 1850 trigonometry and analytic geometry were regularly offered in several of the colleges, and some work in fluxions was given. Following the Civil War the growth of colleges in number, enrollment, and curriculum offerings was more rapid. The first M.A. degree in mathematics granted within the state was conferred on Joseph Swain by Indiana University in 1885. The first Ph.D. in mathematics was granted by Purdue University to James Byrnie Shaw in 1897, but no other Ph.D. degree in mathematics was granted within the state until 1912 when Miss Cora B. Hennel received this degree from Indiana University. Following are the names of the more prominent early mathematicians of Indiana: Bishop Matthew Simpson, John Steele Thomson, John H. Harney, J. Harrison Thomson, John S. Hougham, Emerson E. White, Frank L. Morse, Moses C. Stevens, Erastus Test, John L. Campbell, John P. D. John, Henry T. Eddy, Joseph Swain, Clarence A. Waldo, Arthur S. Hathaway, and Robert J. Aley.

8. Professor Artin showed that the fundamental properties of the Gamma function are derived in a very simple manner if the function be defined as a logarithmic-convex solution of its functional equation. The main reason for the simplicity of the proofs is that the logarithmic-convex functions form a family that is closed under addition, multiplication, and the taking of limits. With very little formal manipulation of symbols Professor Artin was able to obtain all the usual forms which are used to define the Gamma function.

9. Professor Lanczos discussed the motion of a particle in a Riemannian field. Linear differential equations satisfy the principle of superposition; two separate solutions can be superposed on each other without any disturbance. Hence, linear differential equations cannot account for the fact that a particle is put in motion by the action of a superposed external field. The field equations of relativity, based on Riemannian geometry, are non-linear. Thus the possibility is given that here the dynamics of a particle may be understood as a con-

sequence of the field equations. Indeed, the laws of motion can be derived in the form of integral relations based on the Gaussian integral transformation. The equations of motion come out in the classical Newtonian form: 1. The time rate of change of the momentum is equal to the moving force. 2. The momentum is equal to the total mass times the velocity of the center of the mass. The "moving force" can be transformed into a boundary integral, extended over the surface of the particle. The resulting law of motion does not coincide necessarily with the customarily assumed law of the geodesic line.

10. Mr. Gilbarg defined the p -adic absolute value on the rational numbers in the following way: If $m/n = (m'/n') p^{+n}$, then the absolute value of $m/n = p^{-n}$. By means of this sort of absolute value, it is possible to define convergence. In particular, the convergence of the logarithmic series can be discussed from this point of view. The problem of the values taken on by the logarithm function in the p -adic domain was considered.

11. Mr. Crain employed the analytic method to establish the following results: (1) If a circle is cut by a straight line in two points A and B , the locus of the circumcenters of the triangle PAB , where P is any point on the given circle, is a point circle, and the locus of the orthocenters is a circle. (2) The locus of any point, which divides in a constant ratio the line joining the circumcenter and the orthocenter, is a circle. (3) Each member of this family of circles is tangent to two lines which intersect at the circumcenter. (4) Considering only the members of this family which form an unlimited chain of tangent circles, and starting with the circle determined by the orthocenters, their radii taken in decreasing order may be summed.

12. Dr. Weyl's paper was concerned with a generalization of R. Nevanlinna's now classical results about the distribution of meromorphic functions (R. Nevanlinna, *Eindeutige Analytische Funktionen*, Julius Springer, 1936). The principal aim of this theory is the characterization of the class of functions, one-valued on a given Riemann surface F , in terms of the distribution of those places where any one of them assumes given values. If F is the doubly punctured sphere, the corresponding class of functions is called ring-meromorphic. If F is open, one is forced to exhaust it by means of a sequence of ever-expanding regions. For the principal estimates of the classical theory it is furthermore imperative that the exhausting regions exhibit rotational symmetry. How to do this in the classical case, where F is the open euclidean plane, is evident. But the sphere, punctured at the south and north poles, also permits an exhaustion by rotationally symmetric regions. On this basis the classical procedure as well as its results can be reproduced, throwing into sharp relief their dependence on the above symmetry.

13. Dr. Whaples gave a new, simplified proof of the theorem that two isomorphic simple sub-algebras of a simple algebra are connected by an inner automorphism.

P. D. EDWARDS, *Secretary*



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

Section Meetings

M. W. Keller (Secretary), C. N. Mills (Secretary) & C. H. Wheeler III (Secretary)

To cite this article: M. W. Keller (Secretary), C. N. Mills (Secretary) & C. H. Wheeler III (Secretary) (1942) Section Meetings, *The American Mathematical Monthly*, 49:9, 581-588, DOI: [10.1080/00029890.1942.11991287](https://doi.org/10.1080/00029890.1942.11991287)

To link to this article: <https://doi.org/10.1080/00029890.1942.11991287>



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1940 and 1941 income from the Chace Fund for aid in the publication by the American Oriental Society of a volume on Babylonian mathematical tablets by Professor Otto Neugebauer and Doctor A. J. Sachs; (4) to participate formally in symposia Wednesday, December 30, as planned by the Secretaries of Sections A and L, in observance of the 300th anniversary of the death of Galileo and the birth of Newton; (5) to make an appropriation of \$400 in 1943 toward the expense of printing and distributing the National Mathematics Magazine for 1942-43, either as a provision in the 1943 budget or from one of the special funds.

On recommendation of the Finance Committee it was voted (1) to continue to employ the Cleveland Trust Company as our financial adviser for 1943; (2) to utilize the appropriation of \$200 in the 1942 budget, together with any necessary addition, for the expenses of the regional governors to the 1942 annual meeting, to the extent of one-third of the first-class railroad fare to and from the meeting.

The Board adopted formal resolutions empowering the Cleveland Trust Company to sell certain registered bonds for the sake of a desirable reinvestment and empowering the Cleveland Trust Company to collect interest coupons.

Because of the war conditions it was voted to recall our acceptance of the invitation to meet at Boulder in the summer of 1943, and to express our hope that we may meet there when normal times return.

Miss Marjorie J. Groves was appointed an associate editor for 1942.

W. D. CAIRNS, *Secretary-Treasurer*

NINETEENTH ANNUAL MEETING OF THE INDIANA SECTION

The nineteenth annual meeting of the Indiana Section of the Mathematical Association of America was held Friday and Saturday, April 24 and 25, 1942, at Wabash College, Crawfordsville, Indiana.

Sixty registered at the meetings, including the following thirty-three members of the Association: W. C. Arnold, Emil Artin, W. L. Ayres, Juna L. Beal, L. G. Black, I. W. Burr, G. E. Carscallen, K. W. Crain, W. E. Edington, P. D. Edwards, B. C. Getchell, E. L. Godfrey, G. H. Graves, H. E. H. Greenleaf, C. T. Hazard, Cora B. Hennel, F. H. Hodge, H. K. Hughes, M. W. Keller, W. C. Krathwohl, Cornelius Lanczos, Karl Menger, G. T. Miller, Paul Muehlman, P. M. Pepper, J. C. Polley, C. K. Robbins, L. S. Shively, D. R. Shreve, M. S. Webster, F. J. Weyl, K. P. Williams, H. E. Wolfe.

At the business meeting on Saturday the following officers were elected for next year: Chairman, J. C. Polley, Wabash College; Vice-Chairman, P. M. Pepper, Notre Dame University; Secretary, M. W. Keller, Purdue University. The twentieth annual meeting will be held April 9 and 10, 1943, at Notre Dame University.

At the annual dinner on Friday evening the chairman, Professor P. D. Edwards of Ball State Teachers College, acted as toastmaster and introduced Dr. F. Sparks, President of Wabash College, who welcomed the visitors.

Following the dinner the first session of the Section was held with Professor H. T. Davis of Northwestern University as guest speaker. His subject was "Dinner with Archimedes." Professor Davis invited the audience to have dinner with him at the request of King Ptolemy Philadelphus, the second ruler of Alexandria. The dinner was in honor of Archimedes, a distinguished visitor from Syracuse. At the dinner the audience met the various guests King Ptolemy had invited. The amazingly modern work of the Alexandrian Museum of this golden period was revealed in the conversations between these people, and the court of Ptolemy Philadelphus was shown to equal both in luxury and learning that of any in more modern history.

Saturday morning Professor Davis gave a second lecture. His subject was "A mathematical theory of income and its consequences." He considered the problem of representing mathematically the frequency function which describes the distribution of the national income among income recipients. The distribution is characterized by an abnormally large standard deviation, and by the fact that the modal income is very close to the wolf-point, that is to say, the income of subsistence level. For large incomes the distribution must give asymptotically the Pareto law, which asserts that in normal economies the distribution of income is represented by the formula, $y=ax^{-v}$, where y is the number of people having the income x or greater, and v is approximately 1.5. The function which most satisfactorily describes the distribution is given by

$$\phi(x) = \frac{a}{z^n} \cdot \frac{1}{e^{b/z} - 1}$$

where $z=x-c$, $n-v=2$, c is the wolf point, and $\phi(x)$ is the number of people with incomes between x and $x+dx$.

National industrial production, P , represented by the Douglass-Cobb formula, $P=AL^pC^q$, $p+q=1$, where L measures labor and C measures capital, is found to be a function of the concentration of wealth, represented by the ratio, $p=1/(2v-1)$. The relationship between industrial production and the distribution of income is thus exhibited, and certain consequences derived.

At the two sessions on Saturday the following seven papers were presented:

1. "The work of the Indiana Section" by Professor P. D. Edwards, Ball State Teachers College, retiring chairman of the Indiana Section.
2. "On the curvature of surfaces" by Professor Karl Menger, Notre Dame University.
3. "On the value distribution of meromorphic functions" by Dr. F. J. Weyl, Indiana University.
4. "Results of a diagnostic testing and remedial teaching program" by Dr. D. R. Shreve and Dr. M. W. Keller, Purdue University.

5. "Linear and almost linear sets" by Professor P. M. Pepper, Notre Dame University.
6. "Remarks on a problem of Kakeya" by Dr. J. W. T. Youngs, Purdue University, introduced by Professor Ayres.
7. "On curves in 3-space" by Dr. Peter Scherk, Indiana University, introduced by Professor Williams.

Abstracts of papers follow.

1. Professor Edwards gave a summary of the mathematical work presented at the meetings of the Indiana Section of the Association since its organization in 1924. A statistical summary of papers presented, attendance, etc., was included. The influence of the Indiana Section as an organization was noted and attention was called to needs of the immediate future that must be met by the members.

2. Professor Menger showed how the curvature of a curve C at a point P may be defined by a direct limit process, *viz.*, as the reciprocal of the limit of the radii of circumcircles formed for triples of points of C converging towards P . This definition is exclusively based on the distance between the points of C and, hence, is applicable to any curve contained in a general metric space in the sense of Fréchet. In an analogous way, the Gauss curvature of a surface S at a point P may be defined by considering quadruples of points of S converging towards P . However, instead of the circumsphere of a quadruple of points, one has to study the radius of a sphere containing four points whose six distances are respectively equal to those between the points of the quadruple. By a sphere of positive, infinite or negative radius we mean an ordinary sphere in which the distance of two points is the length of the minor arc of the great circle joining the two points, or the Euclidean plane, or the hyperbolic plane, respectively.

3. Dr. Weyl's report dealt with R. Nevanlinna's defect relation for meromorphic functions. As the sharpest and most natural generalization of E. Picard's classical theorem that a meromorphic function cannot leave out more than two values, this relation is sufficiently attractive to warrant the search for a proof of greatest possible simplicity. The one presented by Dr. Weyl was based upon ideas of L. V. Ahlfors and might well be considered simple enough to make Nevanlinna's result a possible candidate for inclusion in any graduate course on Complex Variables.

4. Dr. Shreve gave a report on a three-year experiment in the teaching of trigonometry and elementary algebra to freshmen students of engineering in Purdue University. The control group was taught in the usual manner. The experimental group was given seven lessons in review of elementary algebra preceding the study of trigonometry. In teaching the experimental group the concepts and skills to be given particular emphasis were determined from an error analysis of the difficulties which the students in the control group had encountered. He reported that by this procedure it had been possible to reduce the number of failures by more than thirty-five per cent and increase the number

of A 's by fifty per cent although the control group was initially slightly superior in ability as measured by preliminary tests.

5. Professor Pepper stated that Menger had shown each semimetric space of five or more points all of whose triples are linear is linear and the existence of four point non-linear sets whose triples are all linear. Professor Pepper made a survey for each k of all $(5+k)$ -point semimetric spaces with exactly $k+1$ non-linear triples and showed that each semimetric space of $5+k$ points with at most k non-linear triples is actually linear. He also showed that in any non-linear semimetric space of more than four points at most two points can escape lying in at least one non-linear triple. He gave the following corollary to this: Each non-linear semimetric space which has non-denumerably many points must have non-denumerably many non-linear triples. Congruent imbeddings into function space were given for some of those non-linear spaces which are metric.

6. Dr. Youngs presented an outline of the history of a celebrated problem of Kakeya with a sketch of the elegant solution by Perron.

7. Dr. Scherk showed how some concepts of algebraic geometry can be translated to real non-analytical curves which are assumed to have tangents and osculating planes everywhere. Thus, the local behavior of such a curve can be described by means of a set of three numbers that is the precise generalization of the characteristic (mod 2) of algebraic curves. Since the points of a non-analytic curve are bound together by no tie, one has introduced beside the order, rank, class in the large of such a curve (equal number respectively, of points of the curve in a plane, tangents through a straight line, osculating planes through a point) corresponding local concepts. Assuming reasonable smoothness, he proved that the local order, class, and rank can be expressed through the characteristic in a simple way, and that, especially, the first two are equal. This last result followed at once from the deeper theorem that the first and last of the characteristic numbers are dual to one another, while the second is self-dual.

M. W. KELLER, *Secretary*

THE TWENTY-THIRD ANNUAL MEETING OF THE ILLINOIS SECTION

The twenty-third annual meeting of the Illinois Section of the Mathematical Association of America was held at James Millikin University, Decatur, Illinois, on Friday and Saturday, May 8 and 9, 1942. Professor R. N. Johanson, chairman of the Section, presided at all sessions.

The attendance at the sessions was approximately forty-five, including the following twenty-eight members of the Association: Beulah Armstrong, Edith I. Atkin, S. F. Bibb, O. K. Bower, Laura E. Christman, W. H. Coulter, D. R. Curtiss, J. E. Davis, W. W. Denton, Elinor B. Flagg, A. E. Gault, B. H.

Gere, G. D. Gore, M. R. Hestenes, Mildred Hunt, R. N. Johanson, E. C. Kiefer, J. M. Kinney, W. C. Krathwohl, H. J. Miles, C. N. Mills, G. E. Moore, E. J. Moulton, Margaret Olmsted, F. C. W. Olson, E. W. Ploenges, Ruth B. Rasmussen, E. H. Taylor.

At the annual business meeting the following officers of the Section were elected: Chairman, E. W. Ploenges, James Millikin University; Vice-Chairman, C. N. Mills, Illinois State Normal University; Secretary, E. C. Kiefer, James Millikin University. The members of the Section voted to join with the Indiana and the Michigan Sections in a joint meeting in 1943 to be held at Notre Dame University, the details of this meeting to be announced early next spring. The next regular meeting of the Illinois Section will be held in 1944 at Illinois State Normal University, Normal, Illinois.

The following twelve papers were presented:

1. "Mathematics for the consumer" by Laura E. Christman, Senn High School, Chicago.
2. "The construction and use of a mathematics placement test" by Dr. B. H. Gere, Herzl Junior College, Chicago.
3. "Determinant theory without the use of inversions" by Dr. I. E. Perlin, Illinois Institute of Technology.
4. "Trigonometry for the Navy V-7 program" by Professor G. E. Moore, University of Illinois.
5. "Teaching college geometry from the teacher-training point of view" by Professor C. N. Mills, Illinois State Normal University.
6. "Determinants and Taylor's Theorem" by Dr. Bernard Friedman, Woodrow Wilson Junior College, introduced by the Secretary.
7. "Report of meetings of Board of Governors" by Professor W. C. Krathwohl, Illinois Institute of Technology.
8. "Mathematics and war" by Professor E. J. Moulton, Northwestern University.
9. "A page of vector calculus for sophomores" by Professor G. D. Gore, Central Y.M.C.A. College, Chicago.
10. "Critical points of functions" by Professor M. R. Hestenes, University of Chicago.
11. "Mathematics in the canning industry" by F. C. W. Olson, American Can Company, Maywood, Illinois.
12. "An analogue of Pascal's arithmetical triangle" by Professor S. F. Bibb, Illinois Institute of Technology.

Abstracts of some of the papers follow:

1. High school mathematics may benefit three groups of future citizens: members of professions, members of skilled trades, and consumers. The classical development of high school mathematics aims to help the future member of a profession, essential mathematics and shop mathematics do the same thing for the skilled worker (as far as we can start to grade such needs at this early date) but the consumer is seldom considered in our mathematics program.

Senn High School, Miss Christman stated, is offering a course called "Mathematics for the Consumer" based on the text of the same name by Anna Louise Cowan, published by Stackpole Sons. Decimals and percentage are the mathematical background of the course. Some pupils continue into solid geometry from this course.

2. Dr. Gere outlined a procedure for constructing a placement test. The labor involved in the construction is small but the results are satisfactory for many placement problems. A number of results obtained from the use of a test actually constructed according to this procedure were presented.

4. A three semester hour course designed for men near graduation, with no college mathematics, except perhaps algebra, was described by Professor Moore to show how the University of Illinois meets the needs of the Navy V-7 program. Special emphasis is placed upon computation; half of the course deals with the trigonometry of the earth and the celestial sphere. With the cooperation of Professor R. H. Baker of the Department of Astronomy students are given lectures, outside class time, on celestial coördinates, time (siderial, solar, mean sun, civil), the sextant and its use, star charts, etc.

5. Professor Mills stated that the golden thread which binds many of the different topics in college geometry is "Harmonic Ratio," saying that by means of analytical relations between the various topics usually considered, the student is given a broader point of view of college geometry and projective geometry. Paper folding exercises and properly designed construction plates afford an interesting approach to the general theorems.

6. Dr. Friedman presented a new method for obtaining old and well-known results. If a determinant is considered as a function of any set of its elements and then Taylor's Theorem is applied to this function, the determinant can be expanded into a sum of terms depending upon the particular elements chosen. In this way, the expansion by minors, the characteristic equation of a determinant, Laplace's expansion, Cauchy's expansion and Cayley's expansion (see Muir and Metzler's Theory of Determinants) can be quickly and conveniently found.

9. Professor Gore adapts to several kinds of motion in the plane the derivative of a vector with respect to a scalar. The object is to give to students of the sophomore levels of calculus, mechanics, and engineering kinematics a common language in which to study motion; and to give them greater facility with such entities as displacement, velocity, and acceleration than has been attained by methods that employ only the usual Cartesian and polar coördinates. The simplification of these subjects, which is achieved by a modicum of vector calculus, seems to warrant the introduction of the concept of the vector derivative at an earlier stage than is now customary in mathematical education.

10. Professor Hestenes considered the historical development of the theory of critical points. He made a survey of various definitions of critical points and their indices, and discussed their relation to restricted maxima and minima, considering these topics from an analytic and a topological point of view. He

pointed out how these results can be extended to obtain similar results in the calculus of variations.

11. Mr. Olson discussed some of the mathematical problems involved in determining the proper processing time and temperature to sterilize canned foods. Bacterial death rates as a function of the temperature are combined with the heating equation to form a criterion of sterility whose solution, although of formidable complexity, has been successfully accomplished by tabulation of auxiliary functions, and more recently by nomograms. Fundamental studies of the properties of the heating equation and its solutions have materially increased the usefulness and scope of mathematics as applied to canning problems.

12. Professor Bibb showed how $y_n = f(x)$, obtained by eliminating the parameter t from the pair of equations $x = t + t^{-1}$, $y_n = t^n + t^{-n}$, [$t \neq 0$, $n = 1, 2, 3, \dots$], might be written as $\sum_{s=0}^n (-1)^s ({}_n D_s) x^{n-2s}$, where the ${}_n D_s$ are determinants with elements of the form ${}_n C_p$. He then pointed out the coefficients, ${}_n D_s$, of the polynomials for $n = 1, 2, 3, \dots$, could be arranged as a triangle analogous to that of Pascal.

C. N. MILLS, *Secretary*

THE SPRING MEETING OF THE MARYLAND-DISTRICT OF COLUMBIA-VIRGINIA SECTION

The Spring meeting of the Maryland-District of Columbia-Virginia Section of the Mathematical Association of America was held at Randolph-Macon College at Ashland, Virginia, on Saturday, May 2, 1942, with a morning session, luncheon, and afternoon session. Professor E. J. McShane, chairman of the Section, presided at the sessions.

The attendance was twenty-eight including the following sixteen members of the Association: M. W. Aylor, C. C. Bramble, R. E. Gaines, Isabel Harris, G. A. Hedlund, Evelyn M. Kennedy, A. E. Landry, E. J. McShane, P. W. A. Raine, O. J. Ramler, C. H. Rawlins, Jr., J. N. Rice, R. E. Root, T. McN. Simpson, Jr., C. H. Wheeler III, G. T. Whyburn.

At the invitation of the Section, Dr. G. A. Hedlund of the University of Virginia gave an address on "Symbolic dynamics and topological transformations." A motion was passed expressing the appreciation of the Section to the authorities of Randolph-Macon College for their generous hospitality. The following officers for the ensuing year were elected: Chairman, J. H. Taylor, George Washington University; Secretary, W. K. Morrill, Johns Hopkins University; Members of the Executive Committee, G. A. Hedlund, University of Virginia, O. J. Ramler, Catholic University. The following invitations were accepted for future meetings: Loyola College, Baltimore, Fall meeting, 1942; Johns Hopkins University, Baltimore, Spring meeting, 1943; Trinity College, Washington, Fall meeting, 1943.

After an address of welcome by Dr. J. E. Moreland, President of Randolph-Macon College, the following papers were read:

1. "Quadratic and cubic equations with complex coefficients whose roots have unit modulus" by Professor O. J. Ramler, Catholic University of America.
2. "An application of the calculus of variations to a problem in mechanics" by W. A. Blankinship, University of Virginia, introduced by Professor Whyburn.
3. "Linear velocity fields in a barotropic atmosphere" by Professor R. E. Root, United States Naval Academy.

After these papers there was open discussion on the teaching of college mathematics.

4. "Symbolic dynamics and topological transformations" by Professor G. A. Hedlund, University of Virginia.

Abstracts of the papers follow:

1. Professor Ramler showed that the necessary and sufficient conditions for the roots of the quadratic $z^2 + pz + q = 0$ to have unit modulus are $p/\bar{p} = q$ and $|p| \leq z$. When $p/\bar{p} = q$ and $|p| > 2$ the roots are inverse points with respect to the unit circle in the Argand diagram. He also showed that the necessary conditions for the roots of the cubic $z^3 + pz^2 + qz + r = 0$ to lie on the unit circle are $|p| = |q|$ and $pq/\bar{p}\bar{q} = r^2$. It was also pointed out that when these conditions are satisfied the roots of the Hessian of the cubic are either on the unit circle or inverse points with respect to it.

2. Mr. Blankinship discussed the problem: "To determine the shape that a rod of uniform cross-section and elasticity will assume if forced to pass freely through the three points, $(a, 0)$, $(-a, 0)$, and $(0, b)$." He set it up as a Lagrange problem and obtained an explicit solution in terms of elliptic integrals.

3. Dr. Root stated the general equations of motion relative to a system of axes fixed to the moving earth and discussed some of their general implications. Horizontal motion in which the velocity components are linear functions of displacement coordinates were considered in relation to the requirements of the equations of motion.

4. Dr. Hedlund stated that the methods and examples of symbolic dynamics can be applied to the construction of topological transformations on compact metric spaces. He showed that it was relatively simple to obtain an example which displays most of the properties of the geodesic flow on a closed surface of negative curvature in that there exist transitive orbits, the periodic orbits form an everywhere dense set, and there is a continuum of orbits asymptotic to any given orbit. With the aid of known examples of non-periodic recurrent symbolic trajectories, some of the possibilities in the behavior of non-regular minimal sets can be explored.

C. H. WHEELER III, *Secretary*



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The Fall Meeting of the Indiana Section

M. W. Keller (Secretary)

To cite this article: M. W. Keller (Secretary) (1944) The Fall Meeting of the Indiana Section, *The American Mathematical Monthly*, 51:2, 119-122, DOI: [10.1080/00029890.1944.11991488](https://doi.org/10.1080/00029890.1944.11991488)

To link to this article: <https://doi.org/10.1080/00029890.1944.11991488>



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year would apparently compare favorably with the budget items as estimated at the beginning of the year.

Letters were read from several members protesting against the holding of sessions of the Association on Sunday. No action was taken on the question; but in the discussion the opinion was expressed that such Sunday sessions were necessitated by war conditions, and that there was no intention to continue the practice after the present emergency.

It was voted, on the request of the Secretary-Treasurer, to have a thorough audit of the accounts of the Association at the end of the year, the Finance Committee to arrange for such an audit.

H. M. Gehman of the University of Buffalo was elected a member of the Finance Committee for a term of four years to succeed R. E. Langer.

The Editor-in-Chief nominated and the Board elected the following associate editors of the *MONTHLY* for the year 1944:

E. F. BECKENBACH	H. P. EVANS	M. R. HESTENES
L. M. BLUMENTHAL	B. F. FINKEL	B. W. JONES
N. B. CONKWRIGHT	J. S. FRAME	R. E. LANGER
H. S. M. COXETER	ORRIN FRINK, JR.	C. V. NEWSOM
W. M. DAVIS	MARJORIE GROVES	VIRGIL SNYDER
OTTO DUNKEL		MARIE J. WEISS

At the meeting on Sunday, R. E. Langer was nominated to succeed T. C. Fry as the representative of the Association on the National Research Council for a term of three years beginning July 1, 1944.

ANNUAL BUSINESS MEETING

The annual business meeting of the Association was held on Sunday morning at 9:30, President Cairns presiding.

The results of the election of officers were announced as follows:

First Vice-President for the term 1944-45: W. M. Whyburn, University of California at Los Angeles.

Governors at Large for the term 1944-46: R. G. Sanger, University of Chicago, and Morgan Ward, California Institute of Technology.

W. B. CARVER, Secretary-Treasurer

THE FALL MEETING OF THE INDIANA SECTION

The twenty-first annual meeting of the Indiana Section of the Mathematical Association of America was held at Butler University, Indianapolis, Indiana, on Friday, October 29, 1943, in conjunction with the fall meeting of the Indiana Academy of Science. Professor P. M. Pepper, Chairman of the Indiana Section of the Association, presided at the morning session, and Professor W. E. Edington, Chairman of the Mathematics Section of the Academy, presided at the afternoon session.

Forty-three individuals registered at the meetings, including the following

twenty-five members of the Association: Emil Artin, W. L. Ayres, K. W. Crain, J. E. Dotterer, W. E. Edington, P. D. Edwards, Michael Golomb, G. H. Graves, Cora B. Hennel, M. W. Keller, E. L. Klinger, Gladys B. McColgin, H. A. Meyer, G. T. Miller, Paul Muehlman, P. M. Pepper, J. C. Polley, Maxwell Reade, D. A. Rothrock, C. P. Sousley, M. S. Webster, J. W. Wiley, K. P. Williams, H. E. Wolfe, A. J. Zanolar.

At the business meeting the following officers were elected for next year: Chairman, Emil Artin, Indiana University; Vice-Chairman, W. L. Ayres, Purdue University; Secretary, M. W. Keller, Purdue University. It was decided to hold the next meeting in conjunction with the annual meeting of the Indiana Academy of Science.

The following papers were presented:

1. *Isohedral polyhedra*, by Leon Alaoglu and Dr. J. H. Giese, Purdue University, introduced by Professor W. L. Ayres.

In this paper isohedral and isogonal polyhedra were defined, and it was indicated that the classical regular polyhedra are both isohedral and isogonal. Attention was then directed to polyhedra which are isohedral, but which have isogonality replaced by the weaker property that equal numbers of faces meet at the vertices. It was pointed out that for finite polyhedra of genus zero (topological spheres) the Euler polyhedron formula reduces the possibilities to the usual five, ranging from tetrahedron to icosahedron. Constructions using the greatest possible numbers of unequal edges per face were devised to show the existence of all of these five types except the icosahedron with scalene triangular faces. In the case of genus one (topological tori) the Euler formula reduces the possibilities to triangular, quadrilateral, and hexagonal faces. Constructions were devised to establish the existence of isohedral tori with $12n$ ($n \geq 3$) triangular faces, and of isohedral tori with $8n$ ($n \geq 4$) quadrilateral faces.

2. *The elementary functions*, by Professor Emil Artin, Indiana University.

Professor Artin showed how to introduce the elementary functions e^x , $\log x$, $\cos x$ and $\sin x$ in a completely rigorous manner by using only the simplest facts relating to limits. The results thus obtained cover all properties of these functions, including the infinite product for $\sin x$. It is thus possible to have all these functions available from the beginning in a course in advanced calculus.

3. *A method for the solution of algebraic or transcendental equations*, by Dr Michael Golomb, Purdue University.

The speaker pointed out that the familiar methods for the solution of equations have certain shortcomings. (Newton's and Horner's methods apply only to real roots, while Graeffe's method applies only to algebraic equations, etc.) He derived a new method based upon Hadamard's investigations of the singularities of functions defined by Taylor series. The symmetric functions of the zeros of smallest absolute value were given as limits of quotients of persymmetric determinants involving successive coefficients in the Maclaurin expansion of the reciprocal of the function.

4. *Some developments in the analytic theory of continued fractions*, by Dr. Marion Wetzel, Indiana University, introduced by Professor K. P. Williams.

This address dealt with certain recent contributions to the analytic theory of continued fractions. These contributions have attempted to bring together many isolated results, and fit them into a larger analytic structure. The speaker regarded the continued fraction as an infinite sequence of linear fractional transformations in the complex plane. The class of continued fractions

$$\frac{1}{b_1 + z} - \frac{a_1^2}{b_2 + z} - \frac{a_2^2}{b_3 + z} - \dots, (a_p \neq 0)$$

for which the quadratic form

$$\sum_{p=1}^n \Im(b_p + Z) X_p^2 - 2 \sum_{p=1}^{n-1} \Im(a_p) X_p X_{p+1}$$

is positive definite for all values of $\Im(z) > 0$ was discussed. These continued fractions include the classical case in which $\Im(b_p) = \Im(a_p) = 0$, and also the case $\Im(b_p) \geq 0, \Im(a_p) = 0$, discussed in a paper by Hellinger and Wall in the *Annals of Mathematics*, vol. 44, 1943, pp. 103-127. Necessary and sufficient conditions for positive definiteness in terms of the imaginary parts of the coefficients in the quadratic form were given. The speaker cited some applications of this characterization, including connections with theorems on convergence regions.

5. *Remarks on surfaces*, by Professor J. W. T. Youngs, Purdue University, introduced by Professor M. W. Keller.

Professor Youngs made some expository comments on classical and modern surface theory.

The afternoon session was devoted to a panel discussion of the mathematics training offered for the armed forces in Indiana colleges. The following topics were brought before the meeting:

I. *The content of A. S. T. P. courses with special attention to the relegation of theory to a place of minor importance*, by Professor W. L. Ayres, Purdue University.

II. *Standards for the retention of men in the A. S. T. P.*, by Professor K. P. Williams, Indiana University.

III. *Content of the V-12 program (excluding navigation)*, by Professor J. C. Polley, Wabash College.

IV. *Navigation in the V-12 program*, by Professor R. F. McDaid, Indiana State Teachers College.

V. *Content of courses in the advanced navy program in light of the preparation of the students enrolled*, by Professor Paul Pepper, University of Notre Dame.

VI. *Army pre-flight courses*, by Professor J. L. Beal, Butler University.

VII. *Navy pre-flight courses*, by Professor W. E. Edington, DePauw University.

VIII. *Navy primary and secondary flight courses*, by Professor P. D. Edwards, Ball State Teachers College.

M. W. KELLER, *Secretary*

CALENDAR OF FUTURE MEETINGS

Twenty-Seventh Summer Meeting, Wellesley, Mass., August 12-14, 1944.

The following is a list of the Sections of the Association with dates of future meetings so far as they have been reported to the Secretary.

ALLEGHENY MOUNTAIN, Pittsburgh, Pa.,	NEBRASKA, Lincoln, May 6, 1944
April, 1944	NORTHERN CALIFORNIA
ILLINOIS, Normal, Ill., May 12-13, 1944	OHIO, Columbus, April 6, 1944
INDIANA, Indianapolis, November 10, 1944	OKLAHOMA
IOWA, Cedar Rapids, April 15, 1944	PHILADELPHIA, Philadelphia, November, 1944
KANSAS	ROCKY MOUNTAIN, Greeley, Colo., April 14-15, 1944
KENTUCKY	SOUTHEASTERN
LOUISIANA-MISSISSIPPI	SOUTHERN CALIFORNIA, Los Angeles, March 11, 1944
MARYLAND-DISTRICT OF COLUMBIA-VIR-	SOUTHWESTERN
GINIA	TEXAS
METROPOLITAN NEW YORK, New York,	UPPER NEW YORK STATE
April 22, 1944	WISCONSIN, Milwaukee, May, 1944
MICHIGAN, Ann Arbor, March 18, 1944	
MINNESOTA	
MISSOURI	



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

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To cite this article: M. W. Keller (Secretary) (1945) The Fall Meeting of the Indiana Section, *The American Mathematical Monthly*, 52:5, 294-296, DOI: [10.1080/00029890.1945.11991569](https://doi.org/10.1080/00029890.1945.11991569)

To link to this article: <https://doi.org/10.1080/00029890.1945.11991569>



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THE COORDINATING COMMITTEE

Some Sections of the Association have active committees devoted to the furthering of the interests of sound education in general and of mathematics in particular. Some of these committees have real accomplishment to their credit as a result of advising local educational groups, state boards of education, and legislative committees. They generally find that their advice is treated with respect in such matters as curriculum changes and teacher training.

As post-war educational problems press upon us, it is probable that most if not all of the Sections will find it desirable to establish such committees, possibly in conjunction with other organizations whose aims and ideals are similar to our own. Since education is still a local matter in this country, it is only through local committees, preferably at least one committee for each State, that progress can be made. Not only do the problems vary from place to place, but persons in authority are amenable only to committees of local origin.

With these thoughts in mind, the Board of Governors of the Association has authorized the appointment of a Coordinating Committee whose function it shall be to keep in close touch with all educational movements in the United States and Canada, and to make the information thus acquired available to all committees of the Association and its Sections who can profit by this information. It is hoped that in return all Sectional committees will make contact with the Coordinating Committee and report the problems which are facing them, their plans to meet these problems, and their successes or failures. The Coordinating Committee may be able to supply the local committees with reprints of pertinent articles, or at least with references to them. In any case the local committees should be able to work with more enthusiasm and confidence if they are fortified with exact information about what is going on in other places.

The Association is fortunate in having secured the services of an able committee. The chairman is Professor C. V. Newsom of Oberlin College, Oberlin, Ohio, and the other two members are Professor M. S. Knebelman of the State College of Washington at Pullman, and Professor W. V. Parker of the Louisiana State University at Baton Rouge.

C. C. MACDUFFEE, *President*

THE FALL MEETING OF THE INDIANA SECTION

The twenty-second annual meeting of the Indiana Section of the Mathematical Association of America was held at Butler University, Indianapolis, Indiana, on Friday, November 10, 1944, in conjunction with the meeting of the Indiana Academy of Science. Professor Emil Artin, Chairman of the Section, presided at the morning session, and Professor P. M. Pepper, Chairman of the Mathematics Section of the Academy, presided at the afternoon session.

Thirty-two persons registered at the meeting, including the following eighteen members of the Association: Emil Artin, Juna Lutz Beal, G. E. Carscallen, J. E. Dotterer, W. E. Edington, P. D. Edwards, G. H. Graves, Cora B. Hennel,

M. W. Keller, Mark Lotkin, H. A. Meyer, P. M. Pepper, J. C. Polley, D. H. Porter, J. W. Wiley, K. P. Williams, H. E. Wolfe, Sister Gertrude Marie Zieroff.

At the business meeting the following officers were elected for the next year: Chairman, Juna Lutz Beal, Butler University; Secretary, M. W. Keller, Purdue University.

The following papers were presented:

1. *The great mathematics books in the college curriculum*, by Sister Gertrude Marie Zieroff, O. S. F., Marian College.

In this paper the speaker evaluated the method of learning college mathematics directly from the great mathematics classics. The technique employed for this type of instruction at St. John's College was described. Representative classics were compared with college text-books. The feasibility of using mathematics classics for collateral reading as part of the regular course, for honors courses, and for seminars, was discussed.

2. *On certain recursion inequalities with applications*, preliminary report, by Professor P. M. Pepper, University of Notre Dame.

Professor Pepper dealt with certain problems relating to a switchboard with n terminals, and with wires connecting the terminals in pairs. He considered the determination of the greatest number of cross-connections which can be made without there being somewhere three terminals each two of which are joined by a wire. Knowing the answer to this question, one may ask for a distribution of the maximum number of wires in such a way as to form no triangles (*i.e.*, no three terminals each two of which are connected). In the study of such questions he was led to the consideration of the following auxiliary problem: Let a , b , c , and u_0 be given integers with $a \geq 0$; find a simple formula for u_n in terms of a , b , c , u_0 and n if u_n is the least integer satisfying the inequality

$$u_n \geq [(n + a + c)u_{n-1} - (n + b)]/(n - a), \quad n = 1, 2, 3, \dots$$

The present paper contains a solution of the first two problems and the solution of a two-parameter family of the recursion inequalities with restricted u_0 .

3. *What are we teaching mathematics for?* by Professor G. H. Graves, Purdue University.

In this paper the author pointed out that an essential feature of mathematics is the development of the implications of a set of assumptions. He stated that one of the prime purposes of mathematics is to convey an appreciation of this viewpoint, and that we should examine whether this objective is not in danger of being submerged in the many applications of mathematical processes. It was affirmed that there is a higher practicality to the grasp of a technique for drawing conclusions from a set of data, to the assembling and criticizing of data, and to the investigation of the assumptions on which the argument proceeds, than to any particular results of this process, however important these may be.

4. *Some illustrations of the Hamilton-Jacobi theory*, by Professor K. P. Williams, Indiana University.

Professor Williams explained the importance of the Hamilton-Jacobi differential equation theorems as they apply to planetary theories. An example, in which all integrations could be carried through, was given to show how the solution of one Hamilton system could be made to furnish the solution of a modified system.

5. *Some remarks on final grades in freshman mathematics*, by Professors M. W. Keller and H. S. F. Jonah, Purdue University.

Some data was presented which indicates from a preliminary study that certain tendencies exist in giving final grades when ordinary final examinations are given, when no examinations are given, and when uniform objective final examinations are given.

6. *Determinants*, by Professor Emil Artin, Indiana University.

Professor Artin presented a new set of axioms for determinants. The axioms were: (1) linearity and homogeneity as a function of the columns of a matrix; (2) the vanishing, if two adjacent columns are equal; (3) the value one in case of the unit matrix. From these axioms the speaker led very quickly to all important properties of determinants without introducing more than the elementary notions of permutations.

M. W. KELLER, *Secretary*

CALENDAR OF FUTURE MEETINGS

The Office of Defense Transportation has refused permission for our previously announced meeting at Montreal, June 23-25, 1945, and this meeting has therefore been cancelled.

The following is a list of the Sections of the Association with dates of future meetings so far as they have been reported to the Secretary.

ALLEGHENY MOUNTAIN	NEBRASKA
ILLINOIS	NORTHERN CALIFORNIA, Berkeley, January 26, 1946
INDIANA, Indianapolis, October 19, 1945	OHIO
IOWA	OKLAHOMA
KANSAS	PHILADELPHIA, Philadelphia, December 1, 1945
KENTUCKY	ROCKY MOUNTAIN
LOUISIANA-MISSISSIPPI	SOUTHEASTERN
MARYLAND-DISTRICT OF COLUMBIA-VIR- GINIA, Washington, D. C., May, 1945	SOUTHERN CALIFORNIA
METROPOLITAN NEW YORK	SOUTHWESTERN
MICHIGAN	TEXAS
MINNESOTA	UPPER NEW YORK STATE
MISSOURI	WISCONSIN, Milwaukee, May, 1945



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

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To cite this article: M. W. Keller (Secretary) (1946) The Fall Meeting of the Indiana Section, The American Mathematical Monthly, 53:5, 296-298, DOI: [10.1080/00029890.1946.11991684](https://doi.org/10.1080/00029890.1946.11991684)

To link to this article: <https://doi.org/10.1080/00029890.1946.11991684>



Published online: 11 Apr 2018.



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Professor Frame discussed the determination of cubic surfaces having 27 distinct real lines with coördinates rational in some projective system. By choosing the coördinate planes and the unit plane as the tritangent planes to the surfaces, the equation in projective coördinates (x_1, x_2, x_3, x_4) becomes $x_0x_2x_4 = x_1x_3x_5$ where

$$x_0 + x_1 + x_2 + x_3 + x_4 = a_1x_1 + a_2x_2 + a_3x_3 + a_4x_4 + a_5x_5 = 0,$$

and in which a_1, \dots, a_5 are homogeneous parameters. A plane $\rho x_0 = a_5x_5$ will be tritangent only when ρ is one of the roots λ, μ, ν of the cubic

$$\rho(\rho - a_2)(\rho - a_4) = a_5(\rho - a_1)(\rho - a_3).$$

If we let

$$\xi_0 = \rho x_0, \quad \xi_5 = -a_5x_5, \quad \xi_i = (\rho - a_i)x_i, \quad i = 1, 2, 3, 4$$

we may write the equation of the surface in the form

$$\xi_0\xi_2\xi_4 + \xi_1\xi_3\xi_5 = 0$$

or in any one of the 27 forms obtained from

$$\xi_0(\xi_2 + \xi_1)(\xi_4 + \xi_1) + \xi_1(\xi_3 + \xi_0)(\xi_5 + \xi_0) = 0$$

by letting ρ be λ, μ, ν , and permuting the subscripts 0, 2, 4 and 1, 3, 5 respectively. The first equation displays the nine lines of the form $\xi_0 = \xi_1$, and the second displays the eighteen lines of the form

$$\xi_0 + \xi_1 = \xi_2 + \xi_3 = \xi_4 + \xi_5 = 0.$$

For these lines to be rational we must have the a_i and λ, μ, ν all rational. To accomplish this, assign integral values to a_1, λ, μ, ν , compute the number

$$F = \frac{1}{a_1} (a_1 - \lambda)(a_1 - \mu)(a_1 - \nu) = (a_1 - a_2)(a_1 - a_4)$$

and let $a_2 - a_1$ be any factor R of F . Then

$$a_2 = a_1 + R, \quad a_4 = a_1 + \frac{F}{R}, \quad a_5 = \lambda + \mu + \nu - a_2 - a_4, \quad a_3 = \frac{\lambda\mu\nu}{a_1a_5}.$$

For the 27 lines to be distinct we exclude cases in which a_2 or a_4 is equal to λ, μ, ν . An example of a surface with 27 distinct rational lines is

$$(x_1 + x_2 + x_3 + x_4)x_2x_4 - x_1x_3(2x_1 + 3x_2 + 15x_3 + 8x_4).$$

8. *Sum of the distances to sides of a triangle*, by D. K. Kazarinoff, University of Michigan, introduced by the Secretary.

C. J. COE, *Secretary*

THE FALL MEETING OF THE INDIANA SECTION

The twenty-third annual meeting of the Indiana Section of the Mathematical Association of America was held at Butler University, Indianapolis, Indiana, on Friday, October 19, 1945, in conjunction with the fall meeting of the Indiana Academy of Science. Professor Juna L. Beal presided.

Thirty-three persons registered at the meeting, including the following twenty-one members of the Association: G. E. Albert, W. L. Ayres, Juna L. Beal, Stanley Bolks, I. W. Burr, W. E. Edington, G. H. Graves, Cora B. Hennel, H. K. Hughes, M. W. Keller, E. L. Klinger, H. A. Meyer, A. N. Milgram, G. T. Miller, Ivan Niven, P. M. Pepper, C. K. Robbins, T. Y. Thomas, M. S. Webster, H. E. Wolfe.

At the business meeting the following officers were elected for the next year: Chairman, W. L. Ayres, Purdue University; Vice-Chairman, G. H. Graves, Purdue University; Secretary-Treasurer, M. W. Keller, Purdue University. It was decided to hold the next annual meeting again in conjunction with the Indiana Academy of Science.

The following papers were presented:

1. *A practical form of the comparison test for series of positive terms*, by Professor H. K. Hughes, Purdue University.

Let $\sum u_n$ and $\sum v_n$ be two infinite series of positive terms. If $\lim_{n \rightarrow \infty} (u_n/v_n) = L$, where L is a positive number, then it is well known that the two series are both convergent or both divergent. This modified form of the usual comparison test has not been much used in classes studying series for the first time, but it actually is very practical. The speaker cited examples of series for which a young student might have difficulty in setting up a "comparison series" but which could be handled easily by the test in the form here described.

2. *Statistical methods for controlling the quality of industrial products*, by Professor I. W. Burr, Purdue University.

Since industrial data are statistical in nature, it is only to be expected that they may best be analyzed by statistical methods. In this connection the concepts of frequency distribution, control charts, correlation, and probability are especially useful. It was the purpose of this paper to show how these tools are used in the practical applications, to suggest this field as a new and attractive career, and to point out that there are many unsolved problems.

3. *A program for increasing interest in mathematics in Indiana high schools*, by Professor W. H. Carnahan, Purdue University, introduced by M. W. Keller.

The speaker illustrated by various devices the manner in which he attempts to interest high school students in mathematics by showing them the part it plays in their daily lives.

4. *On length of curves*, by Professor A. N. Milgram, University of Notre Dame.

Let R be a plane region bounded by a simple closed curve J . We say that R bends toward the region at the point $P \subset J$ if there exist arbitrarily small segments in R with endpoints A and B on J in the order APB on a "small" subarc of J . Every simple closed curve has at least three points at which the curve bends toward the region. This may be used to prove that in any closed region which is simply connected two interior points have a unique geodesic joining them. A

simple closed curve J of finite length L has in any ϵ neighborhood a curve interior to J of length $L^* < L$, and exterior to J a curve of length $L^* < L + \epsilon$.

5. *Absolute scalar invariants and the isometric correspondence of Riemann spaces*, by Professor T. Y. Thomas, Indiana University.

Necessary and sufficient conditions for the isometric correspondence of Riemann spaces R_n and \bar{R}_n are given in terms of the equality of absolute scalar invariants of the spaces. In the general case for which the spaces admit a complete set of n functionally independent scalars, it is proved that these and a certain derived set of scalars suffice for the solution of the problem. The solution of the corresponding problem is given for spaces of two dimensions which do not admit two functionally independent scalars.

6. *Symmetry in metric spaces*, by Professor P. M. Pepper, University of Notre Dame.

In an abstract metric space S , a point c is called a *center of pointwise symmetry* if for each x in S there exists a point $y(x)$ such that the distance xc is equal to the distance $cy(x)$ and one half the distance $xy(x)$. If S has at least two centers of pointwise symmetry, then S is unbounded. A point c of S is called a *center of η -symmetry* (fractional symmetry) if $0 < \eta \leq 1$, and for each x in S there exists a point $y(x)$ for which $xc = cy(x)$ and $xy(x) \geq 2\eta xc$. For each positive η less than 1 there exist bounded metric spaces of arbitrarily small diameter with two centers of η -symmetry. (Examples related to the Chebychef polynomials of the second kind are shown for each η less than 1.) A point c of S is called a *center of pointwise open symmetry* if for each number $\eta > 0$ and each x in S there exists a point $y(\eta, x)$ such that $xy(\eta, x) \geq 2xc - \eta$ and $|cy(\eta, x) - xc| \leq \eta$.

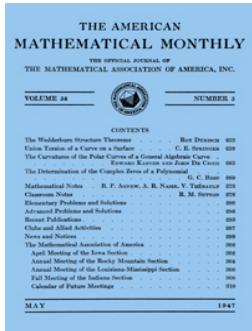
M. W. KELLER, *Secretary*

CALENDAR OF FUTURE MEETINGS

Twenty-eighth Summer Meeting, Ithaca, New York, August 19–20, 1946.

The following is a list of the Sections of the Association with dates of future meetings so far as they have been reported to the Secretary.

ALLEGHENY MOUNTAIN, Pittsburgh, Pa.,	NORTHERN CALIFORNIA, San Francisco,
October, 1946	January 25, 1947
ILLINOIS, Peoria, May 9–10, 1947	OHIO, Columbus, April 3, 1947
INDIANA, Terre Haute, October 18, 1946	OKLAHOMA
IOWA	PACIFIC NORTHWEST
KANSAS	PHILADELPHIA, Philadelphia, November
KENTUCKY	30, 1946
LOUISIANA-MISSISSIPPI	ROCKY MOUNTAIN
MARYLAND-DISTRICT OF COLUMBIA-VIRGINIA	SOUTHEASTERN
METROPOLITAN NEW YORK	SOUTHERN CALIFORNIA, Claremont, March
MICHIGAN	8, 1947
MINNESOTA	SOUTHWESTERN
MISSOURI	TEXAS
NEBRASKA	UPPER NEW YORK STATE
	WISCONSIN



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

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To cite this article: M. W. Keller (Secretary) (1947) Fall Meeting of the Indiana Section, *The American Mathematical Monthly*, 54:5, 308-310, DOI: [10.1080/00029890.1947.11991840](https://doi.org/10.1080/00029890.1947.11991840)

To link to this article: <https://doi.org/10.1080/00029890.1947.11991840>



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FALL MEETING OF THE INDIANA SECTION

The twenty-fourth annual meeting of the Indiana Section of the Mathematical Association of America was held at Indiana State Teachers College, Terre Haute, Indiana, on Friday, October 18, 1946, in conjunction with the fall meeting of the Indiana Academy of Science. Professor W. L. Ayres presided.

Thirty-four persons registered at the meeting, including the following sixteen members of the Association: W. L. Ayres, Juna L. Beal, W. H. Carnahan, G. E. Carscallen, Olive M. Draper, W. E. Edington, P. D. Edwards, Rufus Isaacs, M. W. Keller, J. P. LaSalle, P. M. Pepper, J. C. Polley, M. E. Shanks, W. O. Shriner, F. C. Smith, and C. P. Sousley.

At the business meeting the following officers were elected for the coming year: Chairman, G. H. Graves, Purdue University; Vice-chairman, H. E. Wolfe, Indiana University; Secretary-Treasurer, M. W. Keller, Purdue University. It was decided to hold a spring meeting in 1947 at a time and place to be determined by the officers.

The following papers were read:

1. *The American University at Shrivenham Barracks*, by Professor P. D. Edwards, Ball State Teachers College.

Shrivenham American University, although created by army personnel awaiting redeployment, was a true American University operated on foreign soil. The faculty of more than 220 members represented 149 American institutions of higher education. About 150 were civilians who were sent to England for this purpose. The University was divided into eight sections which correspond to the usual division of an American university into schools. The faculty of the mathematics branch included fourteen civilians and seven members of the army, all of whom were college teachers in civil life. The enrollment was approximately 4000 each term. Approximately three-fourths of the student body had had actual combat experience. An elective system prevailed, and under it the mathematics branch was exceeded in size by only one other branch. In spite of the unusual difficulties which prevailed, very gratifying results were obtained.

2. *The American University at Biarritz*, by Professor J. C. Polley, Wabash College.

The speaker discussed the mathematics program in the American University at Biarritz, and his experiences while there.

3. *Applications of the linear transformation*, by Professor J. P. LaSalle, Notre Dame University.

Several applications of the linear transformation $(az+b)/(cz+d)$ to problems in electrical engineering were presented by Professor LaSalle. A clear geometric picture of the variation of power transfer to a load with change of load or generator impedance, and of the condition for maximum power transfer, was obtained by means of the transformation $(1-z)/(1+z)$. The "circle" diagram

which relates impedance to the reflection coefficient can be used for this purpose. Though the concepts of reflection and transmission coefficients appear to be more natural than those of impedance and the resulting equivalent circuits, particularly for wave guides, only limited use of the former concepts have been made. This may be due to difficulties in applying the general linear transformation. Algebraic identities which simplify the application of this transformation were given.

4. The force of mortality function, by Dr. F. C. Smith, Lincoln Life Insurance.

In this paper, the author discussed the definition of the force of mortality function μ , and some of its properties. Several methods of approximating the values of this function were also presented. The importance of this function in the field of actuarial mathematics was stressed, and the effects of assuming the Gompertz and Makeham hypotheses were shown.

5. Recent progress in the theory of compressible fluids, by Professor Rufus Isaacs, Notre Dame University.

Recent developments make the need for a workable theory of compressible fluids imperative. In the past, progress has been checked, first, by the complexity of the theory, and, second, by the formidable amount of numerical computation needed to apply what theory is extant. The new approach of Bergman to the methods of Chaplygin now yields a usable theory when used in conjunction with such modern computational devices as the Aiken machine at Harvard University. A research program under Professor Von Mises is now under way at Harvard.

In two-dimensional incompressible flows, the stream function (a function whose values completely determine the flow) satisfies the Laplace equation. Thus each flow pattern can be determined from an analytic function of a complex variable by taking the imaginary part. In distinction, for compressible fluids the differential equation satisfied by the stream function is non-linear. But Chaplygin showed that in the hodograph plane (where the velocity components are the independent variables) the equation becomes linear although complicated. Bergman has developed an operator for this equation, wherein a flow can again be obtained for each analytic function. This operator requires knowledge of a certain function sequence which may be (and now is being) calculated once and for all. With this apparatus, all flow patterns may be obtained with comparatively little labor.

6. The achievement of large classes in mathematics (preliminary report), by Professors H. F. S. Jonah, and M. W. Keller, Purdue University.

The authors discuss in this paper the achievement of large classes in mathematics in comparison with achievement of small classes, as measured by uniform objective tests. These preliminary results indicate that for mature groups and selected instructors, large classes are as effective as small classes for teaching algebra and trigonometry.

7. *Hodograph methods for compressible flow*, by Professor M. E. Shanks, Purdue University.

Professor Shanks discussed the types of hodographs obtainable from flow past an airfoil, and pointed out problems unsolved even for incompressible flows. The case of supersonic flows and the method of characteristics were also discussed.

8. *Engineering applications of spherical trigonometry*, by Professor P. M. Pepper, Notre Dame University.

In this paper Professor Pepper describes some of the engineering applications of spherical trigonometry. Since its inception, spherical trigonometry has been applied principally to the sciences of astronomy, geodesy and navigation. It is little known that spherical trigonometry can be useful to the tool engineer, first, to derive the usual formulas for "compound angles" and, second, to solve atypical problems of this nature. Certain of the compound angle formulas are identified with Napier's rules for right spherical triangles, whereas certain of the non-standard problems lead to the laws of oblique spherical triangles.

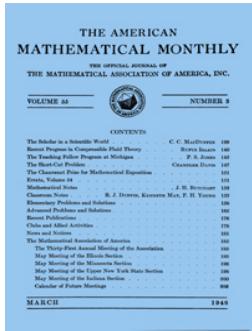
M. W. KELLER, *Secretary*

CALENDAR OF FUTURE MEETINGS

Twenty-ninth Summer Meeting, New Haven, Conn., September 1-2, 1947.
Thirty-first Annual Meeting, Athens, Georgia, January 1, 1948.

The following is a list of the Sections of the Association with dates of future meetings so far as they have been reported to the Secretary.

ALLEGHENY MOUNTAIN	NORTHERN CALIFORNIA, Berkeley, January 24, 1948
ILLINOIS	OHIO
INDIANA	OKLAHOMA
IOWA	PACIFIC NORTHWEST
KANSAS	PHILADELPHIA, Bryn Mawr, November 29, 1947
KENTUCKY	ROCKY MOUNTAIN
LOUISIANA-MISSISSIPPI	SOUTHEASTERN
MARYLAND-DISTRICT OF COLUMBIA-VIRGINIA	SOUTHERN CALIFORNIA, Redlands, March 13, 1948
METROPOLITAN NEW YORK	SOUTHWESTERN
MICHIGAN	TEXAS
MINNESOTA	UPPER NEW YORK STATE
MISSOURI	WISCONSIN, Madison, May, 1947
NEBRASKA	



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

May Meeting of the Indiana Section

M. W. Keller (Secretary)

To cite this article: M. W. Keller (Secretary) (1948) May Meeting of the Indiana Section, *The American Mathematical Monthly*, 55:3, 200-202, DOI: [10.1080/00029890.1948.11991944](https://doi.org/10.1080/00029890.1948.11991944)

To link to this article: <https://doi.org/10.1080/00029890.1948.11991944>



Published online: 11 Apr 2018.



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outside applications than is the underlying theory. In the case of arithmetic, it is necessary to teach technique to children who are too young to appreciate theoretic considerations. The decimal system of notation is regarded by most people as something established by divine decree, rather than as a result of biological accident. With only the most elementary algebraic concepts, one can approach an understanding of arithmetic through a study of the four fundamental operations as they might be developed by creatures with eight or twelve (and so on) fingers instead of ten. One can then proceed to justify these techniques in terms of a general base. Other arithmetical devices, similarly studied, lead to amusing elementary consequences.

5. The present mathematical situation and next steps in the teaching of mathematics, by Dr. William Betz, Rochester, N. Y.

The speaker stated that the mathematical scene is still characterized by a confusion of aims, of content, and of organization. The fundamental thesis of the educator is that "academic" mathematics of the usual type is largely "non-functional," and that it does not "meet the needs" of the vast majority of our young people. The real cause of the present breakdown must be located in a widespread educational opportunism which is without an adequate philosophy in dealing with the problems of mass education. Among the most obvious steps needed to correct the present situation are the following: a nation-wide publicity campaign exposing the folly and danger of current policies; a clear and authoritative analysis of the real meaning of "functional competence in mathematics"; the general adoption of a "two-track program" in secondary mathematics; the planning of a continuous curriculum in secondary mathematics, which shall give due attention to understanding, significant application, and mastery.

6. Panel discussion: Some problems relating to mathematics in New York Colleges, by Professor Wladimir Seidel, the University of Rochester, Chairman; Professor J. M. Synnerdahl, Canisius College; Professor K. E. Bush, Mohawk College; Professor D. E. Kibbey, Syracuse University.

Several problems of the urban college were enumerated by the first speaker. Mr. Bush described several of the courses of instruction in mathematics in the Associated Colleges of Upper New York. He stated that engineering seemed to be the preferred field, and that about three-quarters of the students were studying mathematics. He outlined a number of problems which may arise when the students transfer to other institutions. Dr. Kibbey pointed out that the Associated Colleges and the branch colleges of Syracuse University will feed more students into the advanced courses of the established institutions, and increase the present demand for competent instructors; he predicted enlarged enrollments in such courses as advanced calculus, and raised the question of whether these courses meet the needs of students. Finally, Professor Kibbey discussed the possibility of teaching beginning students some of the fundamental concepts of mathematics to give them some sense of the structure of the science. A general discussion followed.

C. W. MUNSHOWER, *Secretary*

MAY MEETING OF THE INDIANA SECTION

The spring meeting of the Indiana Section of the Mathematical Association of America was held at Purdue University, Lafayette, Indiana on May 16-17, 1947. On Friday evening sixty members and guests attended a dinner in honor of President and Mrs. L. R. Ford. After the dinner Professor Ford gave a lecture entitled *Some Remarkable Theorems About Areas*.

Eighty-one persons attended the meetings, including the following thirty members of the Association: W. L. Ayres, L. G. Black, Stanley Bolks, I. W. Burr, G. E. Carscallen, K. W. Crain, P. D. Edwards, L. R. Ford, E. L. Godfrey,

Michael Golomb, G. H. Graves, W. R. Hardman, C. T. Hazard, H. K. Hughes, Rufus Isaacs, H. F. S. Jonah, M. W. Keller, E. L. Klinger, M. M. Lemme, F. C. Leone, G. T. Miller, P. M. Nastuccoff, Ivan Niven, P. M. Pepper, J. C. Polley, C. K. Robbins, M. E. Shanks, L. S. Shively, R. B. Stone, M. S. Webster, K. P. Williams.

Professor G. H. Graves, Chairman, presided at the business meeting. Professor P. M. Pepper, Notre Dame, was elected Secretary-Treasurer to succeed Professor M. W. Keller who resigned after serving for six years. It was decided to hold a fall meeting again on October 17, 1947 at Ball State Teachers College, Muncie, Indiana, in conjunction with the fall meeting of the Indiana Academy of Science.

The following papers were presented:

1. *Geometries and their terminology*, by Sister Gertrude Marie, O.S.F., Marian College.

In this discussion the speaker traced in parallel the evolution and naming of the various types of geometry, and the history and significance of the names. The purpose of the study was to contribute to an evaluation of current geometric terminology on scientific and linguistic grounds.

2. *A five significant figure slide rule for plane and spherical trigonometry*, by Professor P. M. Pepper, University of Notre Dame.

Professor Pepper demonstrated a slide rule for performing the computations of plane and spherical trigonometry with an accuracy comparable to that obtained by using five-place logarithmic tables. Besides performing all the usual operations, the speaker illustrated how the rule could be used as a five-place table of reciprocals of numbers, of natural trigonometric functions, of logarithms of numbers, and of logarithms of the trigonometric functions.

3. *A simple proof that π is irrational*, by Professor Ivan Niven, Purdue University.

The results obtained in this paper were published in *The Bulletin of the American Mathematical Society*, vol. 53, p. 509.

4. *Remarks on the construction of tables of functions*, by R. D. Gordon, Indiana University, introduced by Professor K. P. Williams.

The speaker discussed briefly the principal devices which make possible the construction of finite tables so as to accommodate "infinitely many" possible calculations. He also indicated how this subject could be introduced in elementary courses.

5. *A congruence on the sums of powers*, by Gordon Overholtzer, Indiana University, introduced by Professor M. W. Keller.

The methods of investigation of the Schur derivate of a sequence were applied to the summation of the k th powers (k being any integer) of the integers from 1 to p^n (p an odd prime) in a single residue class modulo p .

6. *Functional iterates of half-order*, by Professor Rufus Isaacs, University of Notre Dame.

Let g be a functional mapping any set E into itself. Professor Isaacs discussed the existence of a function f of similar type such that for all x in E , one obtains $f(f(x)) = g(x)$. The speaker showed

that the existence criterion is that each linkage can be classified either into a matable pair or as self-matable.

7. Some consequences of Sterling's formula for log $\Gamma(z)$, by Professor H. K. Hughes, Purdue University.

In this paper, the speaker derived some series developments which he had occasion to use. The function

$$\frac{\Gamma(\alpha z + a)\Gamma(\beta z + b)}{\Gamma(\gamma z + c)\Gamma(\delta z + d)}$$

is typical of those developed. Here $\alpha, \beta, \gamma, \delta$ are positive and such that $\alpha + \beta = \gamma + \delta$, and a, b, c, d are any real or complex numbers such that $a + b = c + d$. This function was expanded in the form of a factorial series multiplied by an exponential factor. The results obtained follow from Sterling's formula for $\log \Gamma(z)$.

M. W. KELLER, *Secretary*

CALENDAR OF FUTURE MEETINGS

Thirtieth Summer Meeting, Madison, Wisconsin, September 6-7, 1948.

Thirty-second Annual Meeting, Columbus, Ohio, December 31, 1948.

The following is a list of the Sections of the Association with dates of future meetings so far as they have been reported to the Secretary.

ALLEGHENY MOUNTAIN, Pennsylvania
State College, May 8, 1948

ILLINOIS, Illinois Institute of Technology,
Chicago, May 14-15, 1948

INDIANA, Purdue University, West La-
fayette, May 8, 1948

IOWA, Fairfield, April 16-17, 1948

KANSAS, Atchison, April 10, 1948

KENTUCKY, Berea, May, 1948

LOUISIANA-MISSISSIPPI, Southwestern Lou-
isiana Institute, Lafayette, La., April 23-
24, 1948

MARYLAND-DISTRICT OF COLUMBIA-VIR-
GINIA, United States Naval Academy,
Annapolis, Maryland, May 8, 1948

METROPOLITAN NEW YORK, Washington
Irving High School, April 24, 1948

MICHIGAN, University of Michigan, Ann
Arbor, April 3, 1948

MINNESOTA, College of St. Thomas, St.
Paul, May 8, 1948

MISSOURI, University of Kansas City,
Kansas City, April 23, 1948

NEBRASKA, University of Nebraska, Lin-
coln, May 1, 1948

NORTHERN CALIFORNIA

OHIO, Ohio State University, Columbus,
April 3, 1948

OKLAHOMA

PACIFIC NORTHWEST, Eugene, Oregon,
March 26-27, 1948

PHILADELPHIA, Philadelphia, Pa., Nov. 27,
1948

ROCKY MOUNTAIN, April 23-24, 1948

SOUTHEASTERN, The Citadel, Charleston,
South Carolina, March 19-20, 1948

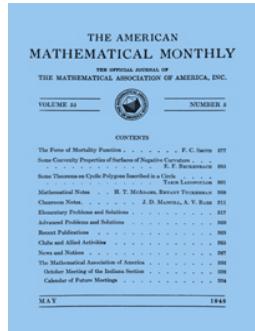
SOUTHERN CALIFORNIA, Redlands, March
13, 1948

SOUTHWESTERN, New Mexico Highlands
University, Las Vegas, New Mexico,
May 3-6, 1948

TEXAS, Rice Institute, Houston, April 23-
24, 1948

UPPER NEW YORK STATE, Schenectady,
May 1, 1948

WISCONSIN, Beloit, May 8, 1948



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

October Meeting of the Indiana Section

P. M. Pepper (Secretary)

To cite this article: P. M. Pepper (Secretary) (1948) October Meeting of the Indiana Section, *The American Mathematical Monthly*, 55:5, 332-334, DOI: [10.1080/00029890.1948.11999244](https://doi.org/10.1080/00029890.1948.11999244)

To link to this article: <https://doi.org/10.1080/00029890.1948.11999244>



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matics and Electronic Computor Branch, Office of the Comptroller, United States Air Forces.

Assistant Professor L. W. Swanson of Coe College has been promoted to an associate professorship.

Professor John L. Synge has been appointed to a Senior Professorship in the School of Theoretical Physics at the Dublin Institute for Advanced Studies. He is resigning from his present position as Head of the Department of Mathematics at Carnegie Institute of Technology as of the end of the academic year, and will take up his duties in Dublin on September 1.

Assistant Professor Leo Zippin of Queens College has been promoted to an associate professorship.

The University of Michigan announces the appointment of S. W. Hahn as instructor.

Mr. A. L. McCarty, formerly of City College of San Francisco, died on June 20, 1947. Mr. McCarty, a charter member of the Association, was one of the organizers of the Northern California section.

Professor Emeritus A. B. Turner of the College of the City of New York died on February 5, 1948 at the age of seventy-five years. He was a charter member of the Association.

Professor G. E. Wahlin of the University of Missouri died on February 11, 1948. He was a charter member of the Association.

THE MATHEMATICAL ASSOCIATION OF AMERICA

Official Reports and Communications

OCTOBER MEETING OF THE INDIANA SECTION

The fall joint meeting of the Indiana Section of the Mathematical Association of America and the Mathematics Section of the Indiana Academy of Science was held at Ball State Teachers College, Muncie, Indiana on October 17, 1947.

Sixty-four persons attended the meeting, including the following twenty-one members of the Association: W. L. Ayres, Juna L. Beal, G. E. Carscallen, K. W. Crain, Olive M. Draper, P. D. Edwards, E. L. Godfrey, G. H. Graves, H. F. S. Jonah, M. W. Keller, F. C. Leone, P. M. Pepper, J. C. Polley, D. H. Porter, C. K. Robbins, A. E. Ross, L. S. Shively, W. O. Shriner, Florence A. Wirsching.

Announcement of the 1948 national meeting of the National Council of Teachers of Mathematics to be held in Indianapolis on April 2-3, 1948, was made by M. H. Ahrendt, of Anderson College.

No business meeting was held. The time and place of the spring meeting for 1948 was to be arranged by the officers of the Section.

The following papers were presented.

1. *Pythagorean triangles*, by John Funderburg and G. A. Jackson, introduced by the Secretary.

In the euclidean plane, an assemblage of points representing Pythagorean triangles is shown to consist of a parabolic lattice set and sets that are multiples of this set. A subset contains all primitive triangles. It is demonstrated that this assemblage of points can be located on systems of hyperbolas, circles, and straight lines. The approximate values of certain constants (including roots of prime numbers, transcendental e and π) are shown to be obtained by the use of convergent or oscillatory series, of which the members are represented by points included in this assemblage of points.

2. *Some special sums of cotangents*, by H. F. S. Jonah, Purdue University.

The speaker illustrated a method for summing certain finite sums of cotangents. The original sums arose in a research project in electrical engineering.

3. *Mathematics teacher training in relation to the proper teaching of undergraduate algebra*, by A. E. Ross, University of Notre Dame.

The speaker discussed a fundamental approach to the teaching of algebra in college, as well as the problems of training teachers to carry out such a program of instruction successfully.

4. *A study of factors related to engineering mathematics at Purdue University*, by Paul Irick, Purdue University, introduced by the Secretary.

The speaker showed the relation between grades in mathematics and various factors such as position of student in graduating class, average grade in high school mathematics, number of high school units in mathematics, and grades on different tests given during orientation period. The study followed the students through the first two years of college mathematics.

5. *A mathematical theory of religion*, by G. H. Graves, Purdue University.

Due to the studies of Whitehead, Russell, Keyser, and others, it is now generally recognized that mathematics has no particular subject matter but is concerned with constructing logical systems on postulates suggested by any field of interest. Religion is a promising field in this connection, for in religion, we constantly observe conclusions and decisions, and hence conduct and character, resulting from postulates held as convictions by an individual or by a society. Just as geometry, for instance, has gained greatly in clearness and in range by a study of its foundations and the recognition of incompatible systems which are nevertheless consistent individually, so it may be expected that different religions can gain in clearness and in tolerance by studying their fundamental postulates with a view to eliminating contradictions and non-essentials, and to tracing the connections of the characteristics of individuals or societies with their fundamental postulates.

6. *A reduced set of postulates for hyperbolic geometry*, by Rev. H. F. DeBaggis, C.S.C., University of Notre Dame, introduced by the Secretary.

The speaker presented a minimal set of postulates for hyperbolic geometry. Independence examples were given for all of the postulates.

7. *The postulates of a tri-operational algebra*, by Rev. F. L. Brown, C.S.C. University of Notre Dame, introduced by the Secretary.

In this paper the speaker presented a set of postulates for a tri-operational algebra, showing the independence of each of the postulates. He presented the minimal set satisfying these postulates and derived a few elementary consequences. (These consequences are among those published by the author in the *Reports of a Mathematical Colloquium*, Issue 5-6, Issue 7, Notre Dame, Indiana.)

8. *Functional representation of partially ordered additive groups*, by Ky Fan, University of Notre Dame, introduced by the Secretary.

For any compact Hausdorff space Ω , the totality $C(\Omega)$ of all real continuous functions defined on Ω may be considered as a partially ordered additive group (p.o.a.g.). Any subgroup G of $C(\Omega)$ which contains all constant functions is obviously a p.o.a.g. with the following three properties: (1) G contains a sub-group R which is group-order-isomorphic to the totally ordered additive group of all real numbers; (2) The sub-group R contains an element e such that for any element f of G , the relation $ne \geq f$ holds for some natural number n ; (3) If for some pair of elements f, g of G , $nf + g \geq 0$ holds for all natural numbers n , then $f \geq 0$. Conversely, for any abstract p.o.a.g. G with properties (1), (2), (3), there exists a compact Hausdorff space Ω such that G is group-order-isomorphic to a sub-group G' of the p.o.a.g. $C(\Omega)$ formed by all real continuous functions on Ω , where G' contains all constant functions.

9. *Geometric illustrations of abstract complexes*, by Charles Brumfiel, Ball State Teachers College, introduced by the Secretary.

The speaker gave two and three dimensional examples of abstract topological complexes. The incidence matrices of an n -complex completely determine its topology. Methods were explained for calculating topological invariants, Betti numbers, and torsion coefficients, by means of the incidence matrices.

P. M. PEPPER, *Secretary*

CALENDAR OF FUTURE MEETINGS

Thirtieth Summer Meeting, Madison, Wisconsin, September 6-7, 1948.

Thirty-second Annual Meeting, Columbus, Ohio, December 31, 1948.

The following is a list of the Sections of the Association with dates of future meetings so far as they have been reported to the Secretary.

ALLEGHENY MOUNTAIN	NORTHERN CALIFORNIA, San Francisco,
ILLINOIS, Illinois Institute of Technology,	January 29, 1949
Chicago, May 14-15, 1948	OHIO
INDIANA	OKLAHOMA
IOWA	PACIFIC NORTHWEST
KANSAS	PHILADELPHIA, Philadelphia, November
KENTUCKY, Berea, May, 1948	27, 1948
LOUISIANA-MISSISSIPPI	ROCKY MOUNTAIN
MARYLAND-DISTRICT OF COLUMBIA-VIRGINIA	SOUTHEASTERN
METROPOLITAN NEW YORK	SOUTHERN CALIFORNIA
MICHIGAN	SOUTHWESTERN
MINNESOTA	TEXAS
MISSOURI	UPPER NEW YORK STATE
NEBRASKA	WISCONSIN



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The May Meeting of the Indiana Section

P. M. Pepper (Secretary)

To cite this article: P. M. Pepper (Secretary) (1949) The May Meeting of the Indiana Section, *The American Mathematical Monthly*, 56:3, 217-220, DOI: [10.1080/00029890.1949.11999364](https://doi.org/10.1080/00029890.1949.11999364)

To link to this article: <https://doi.org/10.1080/00029890.1949.11999364>



Published online: 18 Apr 2018.



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A method of proving that the Riemann integral of a continuous function on a closed interval exists without introducing the notion of uniform continuity was presented. The upper and lower integrals are shown to be additive. Then the difference of the upper and lower integrals, considered as a function of one end-point, is shown to have a derivative identically zero. It then follows that the upper and lower integrals are equal.

11. *Trends in the teaching of algebra*, by Professor K. H. Bracewell, Hamline University.

One hundred thirty-three replies received from a selected list of leading universities and colleges to whom a questionnaire was sent indicate a downward trend in pre-college preparation in algebra. Considerable variation exists among all higher institutions in both the amount of credit and content of courses in college algebra. Very few cover the chapters on theory of investment and infinite series. Permutations and combinations, probability and mathematical induction are in somewhat greater, but still limited, use. Sixty per cent of all schools reporting divide their algebra sections into elementary and advanced classes. No marked difference in practice was distinguished between universities and colleges.

12. *Concrete expression of mathematical ideas: an exhibit*, by Mr. E. J. Berger, Monroe High School, introduced by the Secretary.

The exhibit included about forty articles made by students at Monroe High School. Some of the articles illustrated properties of various algebraic curves, such as the focal properties of the ellipse and parabola. Others were measuring devices such as Jacob's staff, transit, clinometer, and sextant.

L. E. BUSH, *Secretary*

THE MAY MEETING OF THE INDIANA SECTION

The spring meeting of the Indiana Section of the Mathematical Association of America was held at Purdue University, Lafayette, Indiana, on May 8, 1948.

Eighty-two persons attended the meeting including the following forty-seven members of the Association: J. L. Beal, Stanley Bolks, C. F. Brumfiel, Lee Byrne, G. E. Carscallen, K. W. Crain, H. E. Crull, Rev. H. F. De Baggis, M. W. De Jonge, R. H. Downing, Sister M. Virgilia Dragowski, F.O.S.F., P. D. Edwards, Ky Fan, E. L. Godfrey, Noel Gottesman, S. H. Gould, G. H. Graves, W. S. Gustin, Smith Higgins, Jr., Carl Holtom, H. K. Hughes, H. F. S. Jonah, P. S. Jones, M. W. Keller, E. L. Klinger, Florence Long, Sister Mary Ferrer McFarland, R.S.M., Karl Menger, G. T. Miller, P. M. Nastucoff, Paul Overman, Philip Peak, J. C. Polley, P. M. Pepper, C. K. Robbins, Arthur Rosenthal, A. E. Ross, G. X. Saltarelli, L. S. Shively, R. B. Stone, Raimond Struble, Anna K. Suter, G. L. Walker, M. S. Webster, A. M. Welchons, K. P. Williams and M. A. Zorn.

At the business meeting it was decided that the fall meetings which for the past several years have been held jointly with the Mathematics Section of the Indiana Academy of Science will be discontinued. The spring meeting of 1949 will be held at the University of Notre Dame.

P. D. Edwards, Ball State Teachers College, was elected Section Governor. Other officers elected at the meeting are: Chairman, H. E. Wolfe, Indiana Uni-

versity; Vice-chairman, A. E. Ross, University of Notre Dame. P. M. Pepper, University of Notre Dame, continues as Secretary. P. D. Edwards was appointed chairman of a committee of three, the other members to be chosen by him, to investigate the possibility of the Indiana Section compiling a report on the curricula of the colleges of Indiana similar to the report of a committee of the Michigan Section.

Professor Karl Menger of the Illinois Institute of Technology gave an interesting hour lecture entitled *Are Variables Necessary in Calculus?* Professor Menger's paper is to be published in the MONTHLY.

Professor P. S. Jones, University of Michigan, on invitation of the Section, gave a report entitled *Report of a Study of the High School Mathematics Prerequisite to Various College Curricula in Michigan College*. He described the activities and findings of the Committee on High School Mathematics of the Michigan Section of the Mathematical Association of America composed of Professors H. W. Alexander, C. C. Richtmeyer, and the speaker. Further information on this subject is presented in the February, 1949, issue of the MONTHLY in the paper by C. C. Richtmeyer.

The following papers were presented:

1. *On the use of a single axis, and of the unit circle in the teaching of trigonometry*, by Professor J. C. Polley, Wabash College.

The first part of the paper was a discussion emphasizing the lack of both utility and theoretical importance in the so-called vertical axis in the development of trigonometric theory, concluding with the opinion that it might better be abandoned in favor of a system in which the coordinates of points are defined relative to a single axis and a point thereon. The rest of the paper was devoted to a discussion on the more extensive use of the unit circle in trigonometry. In illustration the forms for the sine and cosine of the sum and difference of two angles, and those for the sum and difference of the sines and of the cosines of two angles were derived.

2. *On the teaching of determinants*, by Professor A. E. Ross, University of Notre Dame.

It was the purpose of the speaker to derive the usual properties of determinants from a set of assumptions connected as directly as possible with the solution of systems of linear equations. He considered an $n \times n$ matrix $A = (a_{ij})$ and the related systems of equations (I) $a_i x_j = \beta$. He showed that if a function $V(A) = V(\alpha_1 \dots \alpha_n)$ has the properties

$$(1) \quad V(\alpha_1 \dots c \cdot \alpha_k \dots \alpha_n) = cV(\alpha_1 \dots \alpha_n)$$

$$(2) \quad V\left(\alpha_1, \dots, \alpha_k + \sum_{i \neq k} c_i \alpha_i, \dots, \alpha_n\right) = V(\alpha_1 \dots \alpha_n)$$

$$(3) \quad V(I) = V(e_1 \dots e_n) = 1$$

then

$$(II) \quad \begin{aligned} V(\alpha_1 \dots \alpha_n) x_k &= V(\alpha_1 \dots a_k x_k \dots \alpha_n) = V(\alpha_1, \dots, \sum a_i x_i, \dots, \alpha_n) \\ &= V(\alpha_1 \dots \beta \dots \alpha_n) = V_b. \end{aligned}$$

Thus if $V(A) \neq 0$, then system (I) has solutions x_i and $x_i = V_b / V$ (Cramer's rule). Following Artin, he proved the "product" formula, and, specializing one of the factors, showed that $V(\alpha_1 \dots \alpha_n)$ is the desired multilinear form with the correct rule of signs for the individual terms. The existence

of V with the properties (1), (2), and (3) is proved by induction. In teaching, one may employ areas of parallelograms and volumes of parallelopipeds (which do have properties (1), (2), (3)), together with (II) to derive an equivalent of Cramer's rule without the use of determinants in the usual elementary sense, and thus pave the way for the general geometrical theory.

3. Determination of the area of a triangle from its sides, by Professor E. L. Godfrey, Defiance College, Defiance, Ohio.

The presentation of the theory of simultaneous equations and determinants may well include a method of determining the area of a triangle from the equations of its sides, as well as that commonly given using its vertices.

4. Exponent laws for integral powers, by Professor M. A. Zorn, Indiana University.

The exponent laws for integral powers of the same base are derived by means of a modified induction principle.

5. An introduction to a new theory of elementary complex geometry, by Mr. E. L. Klinger, Purdue University.

To each point in the k th, three-dimensional complex space are assigned coordinates of the form $(x+ik, u+iv)$, or briefly (z, w) , where x, u and v are real variables and k is any real constant. After a discussion of distances, it was shown that the equation of any line, except one lying in planes that are perpendicular to the z -axis, had the form $Ax+Bw+C=0$, where A, B and C are real or complex constants, except when $B=0$. In this case any line through (Z, W) may be represented by the system $z=x+ik, w=L(w)+ia$, if L and a are real constants and L an arbitrary one. Certain derived formulas involving the angle γ of intersection of two lines were discussed.

6. Simplicially interlocking spheres, by Professor William Gustin, Indiana University.

In an n -dimensional Euclidean space let there be given $n+1$ closed spheres S_k such that the simplex T spanning the $n+1$ centers of these spheres is non-degenerate, and such that the simplex spanning any subset of the centers is covered by the spheres with those centers. According to a known theorem, due jointly to Knaster, Kuratowski, and Murskiewicz, there exists a point common to all the spheres S_k and the simplex T . In this note such a point is found by elementary means.

7. Short formulations of Boolean algebra, using ring operations, by Dr. Lee Byrne, Purdue University.

Much interest has attached to recent formulations of Boolean algebras intended to emphasize their character as rings, and thus featuring especially ring operations. Most of these are relatively long, and Dr. Byrne's note was concerned with the question whether a simple formulation of this type might show appreciably more brevity. Leaving closure (and non-emptiness) assumptions tacit, he presented four "transformation" postulates, followed by ten theorems, which suffice to show the system to be a ring, a Boolean ring (i.e. one in which every element is idempotent), and a Boolean algebra (i.e., a Boolean ring with unit). The number of transformation axioms appears to be about two less than in previous versions with a similar approach.

8. On the eigenvalues of symmetric kernels, by Professor Ky Fan and Mr. Norman Haaser, University of Notre Dame.

Let the kernel $K(s, t)$ be real symmetric in $a \leq s, t \leq b$, and such that the classical Hilbert-Schmidt's theory is applicable. (I) Let ξ be a real number and let the eigenvalues λ_i of K be so arranged that $|\lambda_i - \xi| \leq |\lambda_{i+1} - \xi|$, ($i = 1, 2, \dots$). Then for any fixed integer $m > 0$, $|\lambda_i - \xi|$ is the

greatest value which can be taken by the *G. L. B.* of the expression $(\|(\xi K - I)^m f\| / \|K^m f\|)^{1/m}$ when f is orthogonal to $j-1$ arbitrarily fixed functions. (II) From the case $m=1, j=1$ of (I) one obtains directly the inclusion theorem of D. H. Weinstein (*Proc. Nat. Acad. Sci.*, vol. 20, 1934, pp. 529–532). (III) If the eigenvalues of K are bounded from below and so arranged that $\lambda_1 \leq \lambda_2 \leq \dots \leq \lambda_i \leq \dots$, then as limiting case $\xi = -\infty$ of (I), for any fixed even integer m , λ_i is the greatest value which can be taken by the *G. L. B.* of $(K^{m-1}f, f) / (K^m f, f)$ when f is orthogonal to $j-1$ arbitrarily fixed functions. If, in addition, K is positive definite, then it can be shown, as was proved by L. Collatz (*Math. Zeitschr.*, vol. 46, 1940, pp. 692–708) and R. Igglisch (*Math. Ann.*, vol. 118, 1942, pp. 263–275), that the above characterization of λ_i holds for any integer m , even or odd, and $(K^{m-1}f, f) / (K^m f, f)$ is non-increasing with respect to m . (IV) If K, K', K'' are three real symmetric kernels such that

$$K(s, t) = \int_a^b K'(s, r) K''(r, t) dr,$$

and if their respective eigenvalues $\lambda_i, \lambda'_i, \lambda''_i$ are so arranged that

$$|\lambda_i| \leq |\lambda'_{i+1}|, \quad |\lambda'_i| \leq |\lambda''_{i+1}|, \quad |\lambda''_i| \leq |\lambda'_{i+1}|,$$

then $|\lambda_{i+j+1}| \geq |\lambda'_{i+1}| \cdot |\lambda''_{i+1}|$ holds for all $i, j \geq 0$. This inequality implies that, for the composite kernel K , the series $\sum |\lambda_n|^{-1}$ converges. This is a particular case of a theorem due to Lalesco-Gheorghini (cf. Hille-Tamarkin, *Acta Math.*, vol. 57, 1931, p. 31).

P. M. PEPPER, *Secretary*

CALENDAR OF FUTURE MEETINGS

Joint Meeting with American Society for Engineering Education, Troy, New York, June 20–21, 1949.

Thirty-first Summer Meeting, Boulder, Colorado, August 29–30, 1949.

Thirty-third Annual Meeting, New York City, December 30, 1949.

ALLEGHENY MOUNTAIN, West Virginia University, Morgantown, May 7, 1949.

ILLINOIS, Bradley University, Peoria, May 13–14, 1949

INDIANA, University of Notre Dame, May 7, 1949
IOWA, Drake University, Des Moines, April 15–16, 1949

KANSAS, Kansas State College, Manhattan, April 2, 1949

KENTUCKY, Centre College, Danville, May 14, 1949

LOUISIANA-MISSISSIPPI, University of Mississippi, Oxford, April 8–9, 1949

MARYLAND-DISTRICT OF COLUMBIA-VIRGINIA, University of Virginia, Charlottesville, Spring, 1949

METROPOLITAN NEW YORK, Brooklyn College, April 9, 1949

MICHIGAN, Wayne University, Detroit, April 2, 1949

MINNESOTA, Gustavus Adolphus College, St. Peter, May 7, 1949

MISSOURI, University of Missouri, Columbia, April 9, 1949

NEBRASKA, Lincoln, May, 1949

NORTHERN CALIFORNIA

OHIO, Ohio State University, Columbus, April 2, 1949

OKLAHOMA

PACIFIC NORTHWEST, Oregon State College, Corvallis, March 25–26, 1949

PHILADELPHIA, Haverford College, November 26, 1949

ROCKY MOUNTAIN, Colorado School of Mines, Golden, April 22–23, 1949

SOUTHEASTERN, University of Alabama, University, March 18–19, 1949

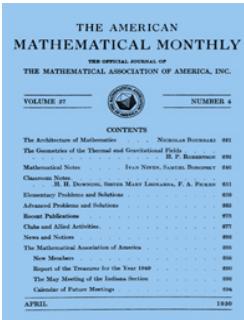
SOUTHERN CALIFORNIA

SOUTHWESTERN

TEXAS, Denton, April 8–9, 1949

UPPER NEW YORK STATE, University of Buffalo, April 30, 1949

WISCONSIN, Lawrence College, Appleton, May 14, 1949



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The May Meeting of the Indiana Section and a Conference on Nonlinear Problems

Paul M. Pepper (Secretary)

To cite this article: Paul M. Pepper (Secretary) (1950) The May Meeting of the Indiana Section and a Conference on Nonlinear Problems, *The American Mathematical Monthly*, 57:4, 292-294, DOI: [10.1080/00029890.1950.11999534](https://doi.org/10.1080/00029890.1950.11999534)

To link to this article: <https://doi.org/10.1080/00029890.1950.11999534>



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VIII. TOTAL FUNDS OF THE ASSOCIATION ON DEC. 31, 1949

Current Fund.....	\$ 7,926.08	M & T Trust Company, Buffalo	
Carus Fund.....	10,337.74	Checking Account.....	\$ 7,926.08
Chace Fund.....	9,003.16	Securities.....	63,600.63
Houck Fund.....	9,861.11		
Chauvenet Fund.....	653.95		
General Fund.....	33,744.67		

	\$71,526.71		\$71,526.71

**THE MAY MEETING OF THE INDIANA SECTION
and a
CONFERENCE ON NONLINEAR PROBLEMS**

The Spring meeting of the Indiana Section of the Mathematical Association of America was held May 7, 1949 at the University of Notre Dame, Notre Dame, Indiana, simultaneously with a Conference on Nonlinear Problems sponsored by the Department of Mathematics of the University of Notre Dame.

One hundred and one persons were present at the meeting, including the following forty-seven members of the Association: Rev. H. B. Albiser, Juna L. Beal, W. R. Beck, C. B. Bell, Stanley Bolks, Richard Brauer, H. E. Burns, G. E. Carscallen, H. E. Crull, Rev. H. F. DeBaggis, CSC, M. W. DeJonge, Sister M. Virgilia Dragowski, OSF, R. D. Edwards, Ky Fan, Cleota G. Fry, E. L. Godfrey, Michael Golomb, S. H. Gould, Noel Gottesman, G. R. Grainger, Sister M. Charlotte Holland, RSM, C. T. Hazard, Smith Higgins, Jr., Ralph Hull, H. F. S. Jonah, Wilfred Kaplan, M. W. Keller, E. L. Klinger, Rev. Bonaventure Knaebel, J. P. LaSalle, Florence Long, Sister M. Ferrer McFarland, RSM, P. M. Nastuccoff, F. S. Nowlan, C. E. Olsen, R. R. Otter, P. W. Overman, P. M. Pepper, J. C. Polley, Arthur Rosenthal, A. E. Ross, G. X. Saltarelli, A. H. Smith, R. A. Struble, Anna K. Suter, W. D. Wood, L. J. Zimmerman.

Officers elected at the meeting were: Chairman, Ralph Hull, Purdue University; Vice-Chairman, J. C. Polley, Wabash College. P. M. Pepper, University of Notre Dame, continues as Secretary. The annual meeting in 1950 is to be held on Saturday, April 29, at Wabash College, Crawfordsville, Indiana.

Professor Richard Brauer, of the University of Michigan, gave an interesting and stimulating talk, entitled *Some Reflections on the Teaching of Algebra*, describing what he believes should be the aims in the teaching of this subject at the undergraduate level in the colleges. Professor Ralph Hull and Professor George Whaples officially led the animated discussion which followed Professor Brauer's provocative comments. The majority seemed to favor, with Professor Brauer, the placing of emphasis on understanding rather than on development of techniques with scant comprehension. Some persons were concerned that this emphasis might lead to the teaching of insufficient techniques. It was brought out in the subsequent remarks that the most satisfactory procedure would strive to accomplish both these aims, and that an attempt should be made to extend this attitude to the teaching in secondary schools.

Dr. Mary L. Cartwright, of Girton College, Cambridge, England, and

Princeton University, gave an address, *On Nonlinear Differential Equations and Some of Their Applications*. Dr. Cartwright illustrated a method for study of nearly linear resonance. This method (due to J. E. Littlewood and the speaker) was applied to the study of the equation $\ddot{x} - k(1 - x^2)\dot{x} + x = pk\lambda \cos(\lambda t + \alpha)$, where k is small and λ is near 1. It was shown that many results can be obtained from the study of a related autonomous system.

Professor P. D. Edwards, Ball State Teachers College, Chairman of the *Committee on High School Mathematical Prerequisites for College Curricula in the State of Indiana*, gave a preliminary report of that committee. Responses have been received from all colleges in the state offering full four year degree courses, and from most others offering work of college grade. Variations existing in the requirements between colleges make the formation of general statements difficult. In most cases the only departments which do not require a knowledge of high school mathematics are English, Foreign Languages, Music, and Art. It is the hope of the Committee that the complete report may be made available to principals and student advisors in each high school in Indiana.

The following papers were presented:

1. *The eigenvalue problem for completely continuous normal operators*, by Professor Michael Golomb, Purdue University.

Most of the classical eigenvalue problems in differential and integral equations may be considered as special cases of the eigenvalue problem for completely continuous linear operators in Hilbert space. An operator is normal if it commutes with its adjoint. Important subclasses of the normal operators are the self-adjoint and the unitary operators. A simple proof is given for the theorem that every completely continuous normal operator has a complete system of eigenfunctions. Similar proofs have been known for completely continuous self-adjoint operators.

2. *The range of synchronization of subharmonic resonance*, by Mr. Hans Schaffner, Department of Electrical Engineering, University of Illinois, introduced by the Secretary.

Mr. Schaffner reported on the range of synchronization when $p\lambda = q\lambda_0$, where p and q are small integers, λ_0 is the resonant frequency, and λ is the frequency of the driving force.

3. *Numerical methods for solution of nonlinear differential equations*, by Professor Wilfred Kaplan, University of Michigan.

Professor Kaplan gave a general method for the analysis of differential equations $dx_i/dt = f_i(x_1, \dots, x_n)$, ($i = 1, \dots, n$) in a bounded phase space. The essential idea is to assume the f_i to be only approximately known. This leads to a blurring of the structure of the family of solutions; fine details are lost while only a simple structure remains; this is considered to be more in accordance with reality than the precise solutions of the exact equations. A numerical method for determining the stable states was given.

4. *Van der Pol's equation with forcing term*, by Dr. Mary L. Cartwright, Girton College, Cambridge, England, and Princeton University, introduced by Professor J. P. LaSalle.

It was suggested by van der Pol that for k very large the equation

$$(1) \quad \ddot{x} - k(1 - x^2)\dot{x} + x = bk\lambda \cos(\lambda t + \alpha)$$

represents a physical system in which two stable subharmonics of period $(2n \pm 1)2\pi/\lambda$ occur. This was investigated by J. E. Littlewood and the speaker. The stable solutions of (1) for k large and $0 < b < 2/3$ consist of descending waves from near $x=2$ to $x=1$, followed by a rapid descent to $x=-2$ approximately, and then a repetition with $-x$ for x . The waves from $x=2$ to $x=1$ are approximately solutions of $x - x^3/3 = b \sin(\lambda t + \alpha) + C$, where C is a constant, and C is reduced by $k^{-1} \int_0^{2\pi/\lambda} x(t, C) dt$ after one complete period. There may be $n \pm (1/2)$ waves above $x=1$, and the same number below $x=-1$, where n is of the order of k , giving solutions with periods $(2n \pm 1)2\pi/\lambda$. There are also unstable solutions with more complicated behavior near $x=\pm 1$.

5. *Nonlinear circuit problems*, by Mr. Hans Schaffner, University of Illinois.

Mr. Schaffner outlined the nonlinear problems which appear important to the electrical engineers, and discussed their present status.

6. *Relaxation oscillations*, by Professor J. P. LaSalle, University of Notre Dame.

Professor LaSalle pointed out that the problem of proving the existence of periodic solutions of differential equations can be reduced in some cases to finding periodic solutions of suitable differential inequalities. The solutions of the inequalities provide a region of the phase plane which encloses a periodic solution (a closed path). This enclosure approximates the closed path and gives bounds for the amplitude and period of the periodic solution.

PAUL M. PEPPER, *Secretary*

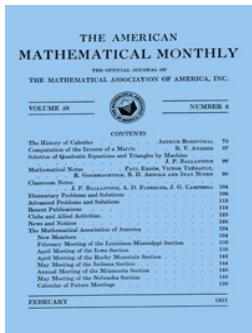
CALENDAR OF FUTURE MEETINGS

International Congress of Mathematicians, Cambridge, Massachusetts, August 30-September 6, 1950.

Thirty-fourth Annual Meeting, University of Florida, Gainesville, December 30, 1950.

The following is a list of the Sections of the Association with dates of future meetings so far as they have been reported to the Secretary.

ALLEGHENY MOUNTAIN, Allegheny College, Meadville, May 6, 1950	Lincoln, May 6, 1950.
ILLINOIS, Southern Illinois University, Carbondale, May 12-13, 1950.	NORTHERN CALIFORNIA, University of San Francisco, January 27, 1951.
INDIANA, Wabash College, Crawfordsville, May 6, 1950.	OHIO, Denison University, Granville, April 22, 1950.
IOWA, State University of Iowa, Iowa City, April 21-22, 1950.	OKLAHOMA
KANSAS, State Teachers College, Pittsburg, April 22, 1950.	PACIFIC NORTHWEST, University of Washington, Seattle, June 16, 1950.
KENTUCKY, University of Kentucky, Lexington, April 29, 1950.	PHILADELPHIA, Lehigh University, Bethlehem, Pennsylvania, November 25, 1950.
LOUISIANA-MISSISSIPPI	ROCKY MOUNTAIN, University of Denver, April 28-29, 1950.
MARYLAND-DISTRICT OF COLUMBIA-VIRGINIA, University of Richmond, May 6, 1950.	SOUTHEASTERN, University of Florida, Gainesville, April 7-8, 1950.
METROPOLITAN NEW YORK, City College, April 1, 1950.	SOUTHERN CALIFORNIA
MICHIGAN	SOUTHWESTERN, Flagstaff, Arizona, April 29, 1950.
MINNESOTA, Macalester College, St. Paul, May 6, 1950.	TEXAS, Abilene, April 14-15, 1950.
MISSOURI	UPPER NEW YORK STATE, Syracuse University, April 22, 1950.
NEBRASKA, Nebraska Wesleyan University,	WISCONSIN, Marquette University, Milwaukee, May 13, 1950.



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

May Meeting of the Indiana Section

J. C. Polley (Secretary)

To cite this article: J. C. Polley (Secretary) (1951) May Meeting of the Indiana Section, *The American Mathematical Monthly*, 58:2, 144-145, DOI: [10.1080/00029890.1951.11999642](https://doi.org/10.1080/00029890.1951.11999642)

To link to this article: <https://doi.org/10.1080/00029890.1951.11999642>



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10. *Problems in the training of teachers of mathematics*, Professor A. W. Recht, University of Denver.

After the program of papers, a joint meeting was held with the Mathematics Section, Eastern Division, Colorado Education Association. The discussion was concerned with the formation of the Colorado Council of Teachers of Mathematics.

J. R. BRITTON, *Secretary*

MAY MEETING OF THE INDIANA SECTION

The twenty-seventh annual meeting of the Indiana Section of the Mathematical Association of America was held at Wabash College, Crawfordsville, Indiana, on Saturday, May 6, 1950. Two sessions were held at which Professor Ralph Hull of Purdue University, Chairman of the Section, presided.

There were sixty-two in attendance including the following thirty-six members of the Association: Juna L. Beal, L. G. Black, Stanley Bolks, C. F. Brumfiel, G. E. Carscallen, W. W. Chambers, T. E. Cheatham, H. E. Crull, M. W. DeJonge, V. E. Dietrich, P. D. Edwards, W. R. Fuller, E. L. Godfrey, Michael Golomb, S. H. Gould, G. H. Graves, J. R. Hadley, N. R. Hughes, Ralph Hull, M. W. Keller, E. L. Klinger, R. A. Lufburrow, R. B. Merrill, P. T. Mielke, P. M. Nastocoff, C. C. Oursler, P. W. Overman, Philip Peak, J. C. Polley, Arthur Rosenthal, M. E. Shanks, Jane A. Uhrhan, R. O. Virts, J. L. Wilson, Florence A. Wirsching, W. D. Wood.

The following officers were elected: Chairman, H. E. Crull, Butler University; Vice-Chairman, M. W. Keller, Purdue University; Secretary, J. C. Polley, Wabash College.

On the matter of awarding Association medals as prizes in high school mathematics contests the chairman was authorized to appoint a committee with power to act. The committee was instructed to investigate the possibility of making such awards in connection with the Indiana State Mathematics Contest and the Indiana Science Talent Search.

The annual meeting of 1951 will be held on Saturday, May 5, the place of meeting to be announced later.

The following papers were presented:

1. *Mathematics for engineers*, by Professor M. E. Shanks, Purdue University.

Of two significant trends in mathematics for freshmen, terminal courses designed solely to fill the cultural gap, and a unified non-compartmentalized course in algebra, trigonometry, and analytic geometry, in part cultural but chiefly motivated by a need for bringing so called advanced ideas down into the undergraduate program, the latter was emphasized. In the author's opinion the need of the modern engineer for the advanced ideas, for pure mathematics, is essential, and once the engineer recognizes that the less traditional course could clearly increase his mathematical "power" he would welcome the change.

2. *A proof of the existence of a real zero for a polynomial of odd degree with real coefficients which is not dependent on continuity*, by Professor J. C. Polley, Wabash College.

This proof of the existence of a real zero for the polynomial $P(x) = \sum_{i=0}^n a_i x^{n-i}$, where the a_i are real, and $a_0 > 0$, is based on the theorems proving the existence: (1) of a number A such that, for all $x > A$, $P(x) > 0$; (2) of a number B such that, for all $x < B$, $P(x) < 0$; (3) of a number $d > 0$ such that, for all x for which $0 < x \leq d$ and $-d \leq x < 0$, $|P(x)| = \sum_{i=0}^{n-1} a_i x^{n-i} < D$, where D is any positive number, however small. The proof consists in showing that at $x = c$, the least x , such that $P(x) > 0$ for all greater x , $P(x)$ can be neither positive nor negative, whence, being defined, it must vanish.

3. The crystallographic groups, by Mr. C. L. Hassell, Purdue University, introduced by Professor Ralph Hull.

The 32 classes of crystallographic groups were described in terms of their representation as subgroups of the full orthogonal groups of three dimensions. It was pointed out that eleven of them are subgroups of the proper orthogonal groups, others are obtained from those of the first kind by adjoining the central reflection, and the rest are obtained from those of the first kind in another way. Illustrations were given for many of the classes, and it was mentioned that apparently no crystal substance is known for one of the classes, or at least this was the case up to 1938.

4. On the content of the first course in mathematical statistics, by Professor C. F. Kossack, Purdue University, introduced by Professor Ralph Hull.

As a first course in mathematical statistics is commonly taught the mathematics is superimposed upon a standard course in statistical methods, each derivation being treated separately and somewhat isolated from the others, whence the student fails to appreciate the theoretical basis of statistical methods. A course should be developed stressing the logical basis of the methods and the inductive approach to problems, introducing the elements of probability as needed and approaching statistical theory from at least a semi-axiomatic basis. The main ideas of hypotheses, testing, etc., should be stressed, and the student's material restricted to the simpler illustrations which he can handle mathematically.

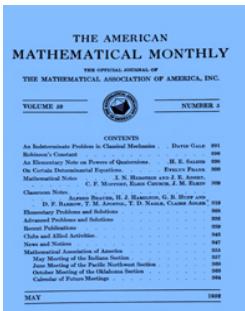
5. Linear graphs and the economics of transportation, by Professor Tjalling C. Koopmans, Director of Research of the Cowles Commission, University of Chicago.

This was an invited address. The theory of linear graphs was applied to finding the most economical routing plan for transportation equipment (ships, say) in carrying out a given program consisting of constant monthly cargo flows between each pair (i, j) of n ports. If, for $i, j = 1, \dots, n$, y_{ij} are cargo flows in shiploads per month, x_{ij} flows of empty ships, t_{ij} and s_{ij} average times for loading and empty movement respectively, b_i the monthly surplus of ships, and Z the amount of shipping required for a routing plan y_{ij}, x_{ij} , then $b_i = \sum_j y_{ij} - \sum_j x_{ij}$ and $b_i = \sum_j x_{ij} - \sum_j y_{ij}$ where $x_{ij} \geq 0$ (thus defining a convex polyhedral set). Hence $Z = \sum_i t_{ii} y_{ii} + \sum_{i,j} s_{ij} x_{ij} = Y + X$, say, where X is a linear function of x_{ij} which has at most one minimum anywhere in the set, but possibly at more than one point.

With any point x_{ij} minimizing X exists a non-negative number set p_{ij} representing nominal prices for a unit of transportation services, and a set p_i representing evaluations of the location of a ship under efficient routing, such that $p_{ij} - p_i + p_i - t_{ii} \leq 0$ and $-p_{ij} + p_i - s_{ij} \leq 0$ for all (i, j) , the former being zero for $y_{ii} > 0$, and the latter zero for $x_{ij} > 0$. The p_{ij} and p_i are the same for all programs permitting an efficient routing plan for which the linear graph G , consisting of all routes (i, j) such that $x_{ij} > 0$, is the same.

Since the p_{ij} are reflected in freight rates in a perfectly competitive market, the analysis applies in developing a system of rates for a regulated transportation system so as to induce social efficiency in the choice of industrial locations by private entrepreneurs.

J. C. POLLEY, *Secretary*



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The May Meeting of the Indiana Section

J. C. Polley (Secretary)

To cite this article: J. C. Polley (Secretary) (1952) The May Meeting of the Indiana Section, *The American Mathematical Monthly*, 59:5, 355-359, DOI: [10.1080/00029890.1952.11988137](https://doi.org/10.1080/00029890.1952.11988137)

To link to this article: <https://doi.org/10.1080/00029890.1952.11988137>



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has a position as Physicist with the Gaertner Scientific Corporation, Chicago, Illinois.

Assistant Professor G. M. Wing of the University of California at Los Angeles has been on leave of absence during 1951-52 and has been a staff member of the Los Alamos Scientific Laboratory, New Mexico.

Mr. R. G. Woodle, Jr., of the Missouri School of Mines and Metallurgy has been appointed to an instructorship at the University of Kansas.

Dr. R. A. Worsing of Iowa State College has joined the Physical Science Division of Boeing Airplane Corporation, Seattle, Washington.

Dr. F. H. Young, who was an AEC Research Fellow at the University of Oregon, is now at the Bureau of Ordnance, United States Navy, Washington, D. C.

Professor Emeritus W. B. Fite of Columbia University died on March 1, 1952. He was a charter member of the Association.

Professor F. G. Graff of Oberlin College died on February 22, 1952.

Dr. C. O. Lampland of the Lowell Observatory died on December 14, 1951. He was a charter member of the Association.

Professor V. S. Lawrence, Jr., of Virginia Polytechnic Institute died on February 20, 1952.

Professor Emeritus C. L. Poor of Columbia University died on September 27, 1951.

THE MATHEMATICAL ASSOCIATION OF AMERICA

Official Reports and Communications

THE EARLE RAYMOND HEDRICK LECTURES

Professor Tibor Radó of the Ohio State University will deliver a series of three expository lectures entitled "Derivatives and Jacobians" as the EARLE RAYMOND HEDRICK LECTURES at the meeting of the Association in East Lansing, Michigan on September 1 and 2, 1952. These lectures have been named in honor of Professor Earle Raymond Hedrick, one of the three organizers of the Association and its first President.

The Board of Governors has established the EARLE RAYMOND HEDRICK LECTURES in an effort to promote expository lectures and publications as significant activities of the Association.

Professor Radó's first lecture will be given at 4 P.M. on Monday, September 1. This lecture, to be devoted to a treatment of Jacobians, is intended to be an exposition which will be readily understood by anyone who is familiar with

advanced calculus and vector analysis as they occur in undergraduate courses.

The second lecture will be given at 9 A.M. on Tuesday, September 2. The first half of this lecture will be a continuation of the first lecture. The second half will be a description of relative Cech cohomology groups as the essential topological tool that is needed in the n -dimensional case. Professor Rado states that he has found a simple treatment of cohomology theory, and he hopes through these lectures to introduce this theory to the analysts for use in their work.

The third lecture will be given at 7:30 P.M. on Tuesday, September 2. This lecture, on a more advanced level than the other two, will be concerned with the transformation theory of multiple integrals in terms of the generalized Jacobians treated in the other two lectures.

Professor Rado states that the material of the three lectures will be published as a monograph of about two hundred pages. The manuscript will be ready for the printer in January, 1953.

The EARLE RAYMOND HEDRICK LECTURES for 1952 have been arranged by a special committee consisting of G. C. Evans, J. C. Oxtoby, and G. B. Price, chairman. At a later date this committee will recommend to the Board of Governors of the Association policies which will govern these lectures in future years.

PREPARATION OF PROBLEM AND SOURCE MATERIALS FOR THE MATHEMATICAL TRAINING OF SOCIAL SCIENTISTS

As readers of this MONTHLY probably know, a Committee on the Mathematical Training of Social Scientists has been at work for some time. The Committee includes representatives of twelve learned societies including the Mathematical Association of America.

As the result of a suggestion from this Committee, the Social Science Research Council is now sponsoring a small group to work during the summer of 1952. This group will attempt to compile from the literature of the various social sciences lists of problems, extracts from sources, and references to sources that illustrate varieties of uses of mathematics in the social sciences. These compilations are expected to serve a number of important ends—e.g., to provide mathematicians with material for use in texts and courses designed for social scientists, to indicate the general dimensions of the mathematical training appropriate for students of the social sciences now and in the future, and to facilitate the study of mathematics by social scientists for whom organized courses are not available.

This Committee believes that the group referred to would find it most helpful if it could start with a wide variety of suggestions from the various areas concerned. A general appeal for such suggestions is hereby made. They should be sent to Professor William G. Madow, Chairman, Committee on the Mathematical Training of Social Scientists, University of Illinois, Urbana, Illinois, as soon as possible.

Although the Committee does not wish to limit the suggestions to specific types of material, it would prefer greater emphasis on materials relating to the use of mathematics in the social sciences themselves than on those relating to statistics, since the materials necessary for statistics are better known. Finally, the Committee would appreciate learning where programs of mathematical training intended for social scientists are now in existence or in process of development, and where mathematics at the level of the calculus or higher is required for undergraduate or graduate degrees in the social sciences or may be substituted for another requirement for a degree in a social science.

THE MAY MEETING OF THE INDIANA SECTION

The twenty-eighth annual meeting of the Indiana Section of the Mathematical Association of America was held at Butler University, Indianapolis, Indiana, on Saturday, May 5, 1951. Two sessions were held at which Professor H. E. Crull of Butler University, Chairman of the Section, presided.

There were fifty-five in attendance including the following forty members of the Association:

W. C. Arnold, W. L. Ayres, Juna L. Beal, Stanley Bolks, C. F. Brumfiel, G. E. Carscallen, K. W. Crain, H. E. Crull, M. W. De Jonge, W. E. Edington, P. D. Edwards, J. L. Erickson, R. A. Gambill, E. L. Godfrey, Michael Golomb, S. H. Gould, G. H. Graves, J. R. Hadley, J. F. Heyda, M. W. Keller, E. L. Klinger, Jacob Korevaar, P. J. McCarthy, Gladys B. McColgin, P. T. Mielke, J. T. Montgomery, P. W. Overman, M. O. Peach, J. C. Polley, Arthur Rosenthal, Sister Gertrude Marie, J. D. Speas, R. B. Stone, Anna K. Suter, A. D. Talkington, Jane A. Uhrhan, F. J. Wagner, M. S. Webster, K. P. Williams, H. E. Wolfe.

The following officers were elected: Chairman, M. W. Keller, Purdue University; Vice-Chairman, Florence Long, Earlham College; Secretary-Treasurer, J. C. Polley, Wabash College.

The chairman announced the election of Professor J. C. Polley of Wabash College to the Board of Governors as Sectional Governor for the three year period July 1, 1951, to June 30, 1954.

Professor P. D. Edwards, Chairman of the Committee on Awards, reported that the committee had awarded five Association medals, four for high mathematical achievement in the Indiana science talent search and one to the top ranking contestant in the final comprehensive contest in mathematics of the Indiana high school achievement program sponsored by Indiana University.

The annual meeting of 1952 will be held at Indiana University, Bloomington, Indiana, at a date to be announced later.

The following papers were presented:

1. *The geometry of ideal gas flows*, by Mr. J. L. Erickson, Indiana University.

The Mach number, m , of a stationary, isoenergetic ideal gas flow in the plane was shown to satisfy a cubic equation of the form $\sum_{n=0}^{n=3} f_n(m^2 - 1)^n$, where the functions f_n are expressible in terms of the adiabatic exponent, the curvature of the streamlines, the curvature of the orthogonal trajectories of the streamlines, and certain derivatives of these curvatures. It is possible to obtain analytic conditions to determine whether or not a given congruence of curves can be streamlined for such a flow.

2. *Continuation of the sequence addition, multiplication, exponentiation, . . . ,*
by Professor S. H. Gould, Purdue University.

Since multiplication is addition with equal summands and exponentiation is multiplication with equal factors, it is natural to define a fourth operation, namely, exponentiation with equal exponents, and then a fifth, and so forth. The higher operations have been neglected on the ground that they are neither associative nor commutative. In the present note these properties were replaced by corresponding inequalities, leading to generalization of some familiar theorems. A compact notation was devised and unsolved problems were suggested. It was pointed out that the notation makes it easy to write numbers which are strikingly large.

3. *Q scores, a correlation study*, by Sister Gertrude Marie, Marian College.

The aim of this paper was to evaluate the mathematics scores of ten consecutive classes of college women in the National Sophomore Testing Program as a measure of mathematical ability and/or achievement. These scores were correlated with: (1) *Q* scores and *I.Q.*'s as given by the American Council of Education Psychological Examination; (2) science, reading comprehension, and total scores on the Cooperative General Culture and English Tests of the National Sophomore Testing Program; (3) high school and college mathematics achievement as indicated by number and kind of courses taken and class marks received.

4. *Linear dependence and the Wronskian*, by Professor M. S. Webster,
Purdue University.

The purpose of this paper was to discuss the theorem "The functions of a set are linearly dependent if, and only if, their Wronskian is identically zero." Although the theorem is in general false, it is found in several texts including two published in the period 1940-1950. Peano and Bôcher recognized that the theorem is not valid and Bôcher published several correct theorems related to the false one. Theorems of this type and a necessary and sufficient condition involving the Gramian were discussed.

5. *Student and teacher*, by Professor G. H. Graves, Purdue University.

Since specialization implies cooperation, mathematicians and educators should work in close collaboration. The graduate student is particularly the victim of misunderstanding between these two groups. The relation between teacher and student is a personal one, not purely professional. The teacher must be profoundly interested in the development of the student's capabilities. When a student fails, the teacher fails with him. Suggestions were made regarding use of class meetings, conferences, psychological aids to study, administration of tests, and the subject of grading. The opinion that the teacher's objectives should include making himself unnecessary was expressed.

6. *The use of a fourth property of a right triangle in teaching mathematics*, by
Professor E. L. Godfrey, Defiance College.

The following theorem is a natural addition to the corollaries concerning the lengths of the sides and the perpendicular to the hypotenuse of a right triangle which are included in the standard textbook presentation of Euclid's eighth proposition of book six. Corollary: The rectangle contained by the sides of a right triangle is equal to the rectangle contained by the base and the perpendicular drawn from the vertex of the right angle to the base. The formula for the altitude suggested by this property was shown to be useful frequently in college mathematics. Since the proof is obvious from a consideration of areas instead of similar triangles, it was suggested as a suitable and useful exercise to introduce in junior high school courses in arithmetic, algebra and/or general mathematics.

7. *On the zeros and asymptotic behavior of Bessel functions*, by Professors

Michael Golomb and Jacob Korevaar, Purdue University, and presented by Professor Korevaar.

In this paper completely elementary methods were used to derive the common results concerning the real and non-real zeros and the asymptotic behavior of Bessel functions; some new results were given on the location of the non-real zeros. No particular representations of the Bessel functions by power series, definite integrals or otherwise were used. For each problem a form of Bessel's differential equation was used which best suited the specific problem. The results then followed readily from the definition of Bessel functions as solutions of the differential equation and were therefore applicable to any (real-valued) solution of this equation, whether it be a Bessel function of the first kind, of the second kind, or a linear combination of such functions.

8. *Newtonian pattern of analysis*, by Professor M. O. Peach, University of Notre Dame.

The concepts of Newtonian mechanics are often extended to phenomena which are essentially non-mechanical. When this is done it should be done consciously and with precision if pitfalls are to be avoided. The author raised the general question: To what extent and under what conditions can non-mechanical phenomena be analyzed according to the pattern of Newtonian mechanics? Precise conditions were laid down for the introduction of the concept of force. A generalized definition of force, applicable to both mechanical and non-mechanical phenomena, was given. Necessary and sufficient conditions for the validity of the parallelogram law for adding forces and of Newton's third law were deduced. An application of these ideas to the theory of dislocations was briefly sketched. The incomplete nature of the answer given to the above question was emphasized, and several directions in which research of potential mathematical interest could be undertaken were pointed out.

9. *A theorem on improper integrals in abstract spaces*, by Professor P. T. Mielke, Wabash College.

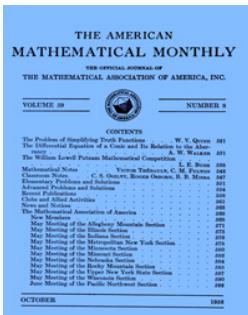
In this paper the notion of improper integral is that used by H. Hahn and A. Rosenthal in *Set Functions*, the University of New Mexico Press, 1948. The theorem proved is one of several contained in the author's doctoral thesis, *Improper Integrals in Abstract Spaces*. The space E is to be considered a general space without any particular topological or metric structure; M a σ -field of subsets of E , $\phi(M)$ a totally additive set function in M which is assumed complete for ϕ . The function $f(x)$ is a point function, ϕ -measurable on a set $A \in M$. Theorem: If $\phi(A)$ is infinite and $f(x)$ is ϕ -summable on A , then, given $\epsilon > 0$, there exists a $\bar{\delta} > 0$ such that for every δ -scale $\{z_i\}$ with $\delta \leq \bar{\delta}$

$$\left| L(f, \phi, \{z_i\}, A_\delta) - (A) \int f d\phi \right| < \epsilon$$

where $A_\delta = A [|f(x)| > \delta]$ and $L(f, \phi, \{z_i\}, A_\delta)$ is any of the four Lebesgue sums for $f, \phi, \{z_i\}$, and A_δ .

Professor J. B. Irwin of the Department of Astronomy of Indiana University delivered by invitation an address entitled *The Possibilities of the Electronic Computer in Astronomical Research*. In this he discussed the nature and construction of recently developed computers and presented certain problems in astronomy to illustrate the possible use of the electronic computer in astronomical research.

J. C. POLLEY, *Secretary*



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The May Meeting of the Indiana Section

J. C. Polley (Secretary)

To cite this article: J. C. Polley (Secretary) (1952) The May Meeting of the Indiana Section, *The American Mathematical Monthly*, 59:8, 576-578, DOI: [10.1080/00029890.1952.11988196](https://doi.org/10.1080/00029890.1952.11988196)

To link to this article: <https://doi.org/10.1080/00029890.1952.11988196>



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concepts of general educational worth now found in later years of high school mathematics that should be brought down into ninth or tenth year mathematics. Eventually, through experimental work, the committee hopes to develop new and better high school mathematics courses.

Miss Seybold then mentioned the core curriculum as a teaching trend not suitable for mathematics instruction and introduced the plan for college admission in bulletin No. 9 of the Illinois Curriculum Program, the objective of which plan is to make way for experimental high school courses.

A report by Mr. Edgar Leach on his work as a member of the Steering Committee of the Illinois Curriculum Program was read.

Dr. E. L. Welker analyzed Volume IV, "*Did They Succeed in College?*," by Chamberlin and Chamberlin of the reports on the Eight Year Study, which study is often quoted as having proved that the pattern of subjects a student takes in high school has no effect upon his college success. Dr. Welker stated that in his opinion the study was not valid and that the statistical techniques were highly inadequate.

Professor Gertrude Hendrix spoke on difficulties in implementing the college admission plan in bulletin No. 9. She pointed out confusion and incompleteness in implementation of the proposed admission plan and gave the results of a study at Eastern Illinois State College. Of a total of 2002 freshman admissions, 1947-50, the number of survivors is 886 or 44%. Of seventy freshman admissions on General Educational Development tests in the same period only ten students, or 14%, survive, and some of these ten may not graduate.

Professor Seybold then called on Professor Cairns to speak informally. Dr. Cairns described the rising concern of people both inside and outside of Illinois over the problem of the poor preparation for life and for college which so many children are now receiving in school. A discussion followed during which resolutions were adopted. A committee will be appointed to implement these resolutions.

E. C. KIEFER, *Secretary*

THE MAY MEETING OF THE INDIANA SECTION

The twenty-ninth annual meeting of the Indiana Section of the Mathematical Association of America was held at Indiana University, Bloomington, Indiana, on May 3, 1952. Two sessions were held at which Professor M. W. Keller of Purdue University, Chairman of the Section, presided.

There were fifty-nine in attendance including the following thirty-nine members of the Association:

Juna L. Beal, L. G. Black, Stanley Bolks, C. F. Brumfiel, G. E. Carscallen, W. W. Chambers, H. E. Crull, R. E. Dowds, W. E. Edington, P. D. Edwards, R. E. Ekstrom, E. L. Godfrey, S. H. Gould, G. H. Graves, H. E. H. Greenleaf, J. R. Hadley, Ralph Hull, M. W. Keller, Florence Long, Saunders MacLane, D. S. Merrilees, G. T. Miller, J. A. Nickel, P. W. Overman, T. P. Palmer, J. C. Polley, D. H. Porter, Arthur Rosenthal, R. M. Ross, J. F. Schell, C. P. Sousley, Anna K. Suter, T. Y. Thomas, Jane A. Uhrhan, M. S. Webster, K. P. Williams, H. E. Wolfe, R. C. Wrede, J. W. T. Youngs.

The following officers were elected: Chairman, Professor M. A. Zorn, Indiana University; Vice-Chairman, Professor C. P. Sousley, Rose Polytechnic Institute.

The annual meeting of 1953 will be held at Ball State Teachers College, Muncie, Indiana, on May 2.

The following papers were presented:

1. *On two topics in advanced calculus*, by Professor George Whaples, Indiana

University, introduced by Professor H. E. Wolfe.

Simple methods are outlined for deriving trigonometry from the differential equation satisfied by the sine function and for proving the theorems on implicit functions by use of sequences of linear approximations.

2. *Conics among the Greeks*, by Professor S. H. Gould, Purdue University.

After a brief discussion of some examples of conics in literature and art, and of the exact meaning of the names, parabola, hyperbola, and ellipse, the speaker undertook to show that every modern definition of a conic appears, in more or less explicit form, in the works of the Greek mathematicians.

3. *An elementary derivation of the formula of Foucault*, by Professor P. D. Edwards, Ball State Teachers College.

Draw a circle in a plane tangent to the surface of the earth and sufficiently small that the radius may be considered either as a straight line or an arc of a great circle of the earth. Due to the rotation of the earth the points of the circle farthest from the pole move toward the East faster than the center. By familiar formulas of trigonometry it is shown that this difference in speed gives a relative motion about the center that is identical with the formula of Foucault. The only advantage of the method is that it can be understood by students who are studying trigonometry, whereas the development of the Foucault formula by the usual methods of dynamics involves rather difficult differential equations.

4. *Some elementary principles of circulates in different number scales*, by Professor E. L. Godfrey, Defiance College.

An experimental study of a tabulation of the circulates of the reciprocals of prime numbers expressed in successive scales of notation suggested an arrangement for each prime, p , of its circulates into $p-1$ groups. In each of these groups there is a constant difference between the corresponding digits of the circulates for radix r and $r+p$. The digits of this difference were shown to be equal to the successive powers of r modulo p . A discussion of some of the further properties of these differences resulting from experimental study included some suggestions concerning the possible use of such studies in the teaching program.

5. *Unified theories of relativity*, by Professor Vaclav Hlavaty, Indiana University, introduced by Professor H. E. Wolfe.

The speaker presented a brief outline of different attempts to obtain the unified theory of relativity (Weyl, Kaluza, Schrödinger) and the solution of Einstein's basic problems of the theory.

6. *Homological algebra*, by Professor Saunders MacLane of the University of Chicago, President of the Association. (By invitation.)

Recent developments in algebraic topology and in the homology theory of groups and of other algebraic systems indicate the existence of a new branch of algebra which may be dubbed "homological algebra." A preliminary notion of this subject, that of the kernel and the image of a homomorphism, may be illustrated even in the simple examples, such as the homomorphism $x \rightarrow e^{2\pi i x}$ of the additive group of reals into the multiplicative group of complex numbers. In this connection, the notion of an exact sequence of groups and homomorphisms is introduced, and the 5-lemma for such exact sequences is established.

The central concept of homological algebra is that of a differential group A , composed of an abelian group A and a homomorphism $\partial: A \rightarrow A$ with $\partial\partial = 0$. Each such differential group determines a homology group $H(A)$, defined as the quotient of the kernel of ∂ by the image of ∂ . If A has a differential subgroup A' , this determines a quotient differential group $\tilde{A} = A/A'$; the asso-

ciated sequence $H(A') \rightarrow H(A) \rightarrow H(\bar{A}) \rightarrow H(A') \rightarrow \dots$ is exact. If a homomorphism f of A with subgroup A' into a second differential group B with subgroup B' induces isomorphisms on $H(A')$ and $H(\bar{A})$, the 5-lemma may be used to prove that f also induces an isomorphism of $H(A)$ to $H(B)$. It was indicated how this and similar results may be used to establish the equivalence of different definitions of homology theories for various types of mathematical systems.

J. C. POLLEY, *Secretary*

THE MAY MEETING OF THE METROPOLITAN NEW YORK SECTION

The eleventh annual meeting of the Metropolitan New York Section of the Mathematical Association of America was held at Hofstra College, Hempstead, New York, on May 3, 1952. Mr. E. I. Shapiro, Vice-Chairman of the Section, presided at the morning session, and Professor James Singer, Chairman of the Section, presided at the afternoon session.

One hundred fifty-one persons attended the sessions, including the following eighty-four members of the Association:

R. G. Archibald, I. L. Battin, Brother Bernard Alfred, W. W. Bessell, Samuel Borofsky, C. B. Boyer, Benjamin Braverman, A. B. Brown, Charlotte Brown, J. H. Bushey, Jewell H. Bushey, P. J. Cocuzza, L. W. Cohen, T. F. Cope, W. H. H. Cowles, I. A. Dodes, J. N. Eastham, J. E. Eaton, W. H. Fagerstrom, A. B. Farnell, J. M. Feld, Daniel Finkel, Edward Fleisher, William Forman, R. M. Foster, B. P. Gill, A. J. Goldman, I. L. Goldman, Bernard Greenspan, Harriet M. Griffin, Carl Hammer, Frank Hawthorne, G. C. Helme, H. H. Hinman, E. Marie Hove, R. J. Jaeger, Jr., D. B. Jordan, L. S. Kennison, G. A. Keyes, E. R. Kiely, H. S. Kieval, M. S. Klamkin, David Kotler, Edna Kramer-Lasser, H. C. Kranzer, C. H. Lehmann, M. E. Levenson, Walter Littman, E. R. Lorch, W. A. Lucas, J. D. Matheson, G. J. Mazzara, F. H. Miller, Morris Morduchow, A. J. Mortola, G. R. Mott, A. F. Nickl, C. J. Oberist, L. F. Ollmann, Martin Orr, J. J. Quinn, M. R. Reeks, Moses Richardson, Selby Robinson, N. J. Rose, H. D. Ruderman, J. P. Russell, J. B. Ryan, John Salerno, Charles Salkind, Arthur Sard, A. H. Sarno, Abraham Schwartz, Aaron Shapiro, E. I. Shapiro, James Singer, F. E. Smith, E. R. Stabler, Mildred M. Sullivan, R. L. Swain, L. F. Tolle, A. W. Tucker, J. A. Vollkommer, Sue R. Waldman.

The officers elected at the business meeting were: Chairman, Professor L. F. Ollmann, Hofstra College; Collegiate Vice-Chairman, Professor W. H. Fagerstrom, The College of the City of New York; High-School Vice-Chairman, Mr. H. D. Ruderman, Manhattan High School of Aviation Trades; Secretary, Dr. H. S. Kieval; Treasurer, Mr. Aaron Shapiro, Midwood High School.

At the business meeting, the following report on the activities of the Committee on Contests and Awards was given by its chairman, Professor W. H. Fagerstrom: "The Committee on Contests and Awards of the Metropolitan New York Section of the Mathematical Association of America enlarged its area of operation this year to include the state of Connecticut along with its own area which includes southern New York, Long Island, and northern New Jersey. In addition, the University of Oregon and the University of British Columbia conducted their own contests but used the questions of the Metropolitan New York Section. One hundred thirty-three invitations were sent out to the larger high schools in the other 44 states of the union, not more than four invitations going to any one state. The registration of 39 schools from 29 states was most gratifying. There were 295 schools registered for the contest and



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The May Meeting of the Indiana Section

J. C. Polley (Secretary)

To cite this article: J. C. Polley (Secretary) (1953) The May Meeting of the Indiana Section, *The American Mathematical Monthly*, 60:8, 588-590, DOI: [10.1080/00029890.1953.11988362](https://doi.org/10.1080/00029890.1953.11988362)

To link to this article: <https://doi.org/10.1080/00029890.1953.11988362>



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which affords a means for obtaining the complementary function of a second order linear differential equation with constant coefficients and imaginary "roots" without resorting to Euler's expression for $e^{i\theta}$.

4. *Concerning metamathematics and Gödel's theorem*, by Mr. F. C. DeSua, University of Pittsburgh, introduced by the Secretary.

An exposition of some methods and results in metamathematics was presented. Results were stated informally without proof although heuristic accounts were given of Gödel's theorem and of Post's proof of the consistency of the propositional calculus.

5. *Some functions related to harmonic functions*, by Professor I. M. Sheffer, The Pennsylvania State College.

Let $u(x, y)$ be an analytic function of the real variables x, y and such that the power series for u and all its derivatives converge in and on a fixed circle C . There exist such functions u that are non-harmonic and such that u and all its derivatives satisfy the Gauss mean value theorem for this one circle C . Properties of these functions are examined. In particular, they satisfy a linear, homogeneous partial differential equation of infinite order in the Laplacian Δu , with constant coefficients.

6. *Exterior forms in Hilbert space*, by Professor T. T. Tanimoto, Allegheny College.

A Grassmann algebra of multilinear mapping in Hilbert space is constructed and a few applications are given.

7. *On finding the characteristic equation of a square matrix*, by Mr. W. Berger and Professor E. A. Saibel, Carnegie Institute of Technology, presented by Mr. Berger.

Using the elementary operations which leave the characteristic equation of the matrix unchanged, it is always possible to transform the matrix such that there is an array of zeros in the lower left-hand corner below the sub-diagonal. Using the Cayley-Hamilton theorem and post-multiplying by the column matrix $\{1, 0, 0, \dots, 0\}$, a triangular set of equations in the coefficients of the characteristic equation results.

8. *The minimum essentials of a required course in mathematics for business majors*, by Professor Mary A. Goins, Marshall College.

The need for an adequate course in mathematics for students in business curricula prompted this study. A questionnaire containing twenty topics thought to be fairly representative of the minimum content of a reasonably adequate required course in mathematics for business students, with space provided for other suggested topics, was sent to the deans of forty-five professional schools of business in Colorado, Florida, Louisiana, Maryland, Michigan, Oregon, and Texas. The replies were tabulated and analyzed with reference to each curriculum. The final analysis showed that the topics mentioned more than fifty percent of times in all curricula might be taught adequately in a three semester-hour course. If six semester-hours were given to the subject, the topics which were required by all of the schools in all curricula could be taught thoroughly.

F. H. STEEN, *Secretary*

THE MAY MEETING OF THE INDIANA SECTION

The thirtieth annual meeting of the Indiana Section of the Mathematical Association of America was held jointly with the Indiana Council of Teachers

of Mathematics at Ball State Teachers College, Muncie, Indiana, on May 1 and 2, 1953. A dinner meeting on Friday evening was addressed by Professor R. E. Langer of the University of Wisconsin on the topic, "Teaching—a job or a profession."

Professor C. P. Sousley, Vice-Chairman of the Indiana Section of the Association, presided at the general session and at the sectional meetings of the Association on Saturday. The general session was devoted to a panel discussion on the academic training of secondary school teachers of mathematics. Professor P. D. Edwards, Head of the Mathematics Department of Ball State Teachers College, acted as moderator, and members of the panel were Professor W. L. Ayres, Dean of the School of Science, Purdue University, Professor Philip Peak of the School of Education, Indiana University, and Mr. R. O. Virts, Chairman of the Mathematics Department and Vice-Principal, Central High School, Fort Wayne, Indiana. The discussion was summed up by Professor R. E. Langer of the University of Wisconsin.

A sectional meeting of the Association devoted to short papers followed the general session in the morning and was continued following the business meeting in the afternoon.

There were one hundred eighteen in attendance including the following thirty-nine members of the Association:

H. W. Alexander, W. L. Ayres, Juna L. Beal, Stanley Bolks, C. F. Brumfiel, W. W. Chambers, K. W. Crain, H. E. Crull, D. E. Deal, M. W. DeJonge, Olive M. Draper, W. E. Edington, P. D. Edwards, S. H. Gould, H. E. H. Greenleaf, Ralph Hull, M. W. Keller, E. L. Klinger, R. E. Langer, Olive Lescow, Florence Long, Gladys B. McColgin, G. T. Miller, Vera T. Morris, Gloria Olive, P. W. Overman, T. P. Palmer, Philip Peak, J. C. Polley, D. H. Porter, Arthur Rosenthal, R. M. Ross, A. R. Schmidt, Sister Gertrude Marie, Aubrey Henderson Smith, C. P. Sousley, Anna K. Suter, R. O. Virts, and M. S. Webster.

The following officers were elected: Chairman, Professor C. P. Sousley, Rose Polytechnic Institute; Vice-Chairman, Professor H. W. Alexander, Earlham College; Secretary-Treasurer, Professor J. C. Polley, Wabash College.

The following papers were presented:

1. *The General Electric fellowship program for secondary school teachers of mathematics*, by Professor Ralph Hull, Purdue University.

The nature and purpose of the General Electric fellowship program, the selection of participants, and plans for its operation on the Purdue campus during the summer of 1953 were described.

2. *Plastic-strip models for non-euclidean geometry*, by Professor H. W. Alexander, Earlham College.

If a narrow, straight strip is cut from thin plastic and laid upon a curved surface in as close contact as possible, it will tend to lie upon a geodesic. If a suitable mesh of geodesics is chosen upon a curved surface, then an approximate model of the surface may be constructed by fastening narrow plastic strips together in a pattern isometric to that on the curved surface. This method is used to fabricate models for non-euclidean geometries of elliptic and hyperbolic type. We thus obtain flexible sections of the sphere and the pseudosphere.

3. Is undergraduate mathematics part of general education?, by Sister Gertrude Marie, Marian College.

Discrepancy between general education values of mathematics and the place accorded to mathematics in undergraduate curricula of representative colleges and universities is shown. Resources of mathematics capable of contributing significantly to realization of objectives of general education are balanced against the trend to relegate the subject to the status of "not required" or "alternative with science or philosophy." Recommendations include re-examination of the relationship of mathematics to other disciplines, revaluation of course materials on the basis of general importance, adoption of improved methods and newer instruction media, logical combination of branches of mathematics, and integration of subject matter with the student's total experience.

4. The School and College Study of Admission with Advanced Standing, by Professor J. C. Polley, Wabash College.

A brief description of a study, financed by grants from the Fund for the Advancement of Education, in which twelve colleges and twelve secondary schools are collaborating to examine the feasibility of, and set up standards for, granting college credit for courses taken in secondary school. Considered in particular are recommendations of the sub-committee on mathematics concerning a course sequence for the tenth, eleventh, and twelfth years, designed to replace present offerings and cover materials frequently included in the first year of college mathematics.

5. Visualization in the integral calculus, by Professor S. H. Gould, Purdue University.

On the principle that "ontogeny recapitulates phylogeny" the speaker discussed the advantage that can be gained in present day classrooms by visualizing the early attempts in the history of mathematics to find the volume of various solids.

6. Sequential limit spaces, by Professor J. L. Lawrence, Wabash College, introduced by Professor Polley.

Necessary and sufficient conditions on the collection of open sets are obtained in order that a subset having x as a limit point will contain a sequence of distinct points convergent to x . Such spaces are shown to be completely determined by a knowledge of the convergent sequences.

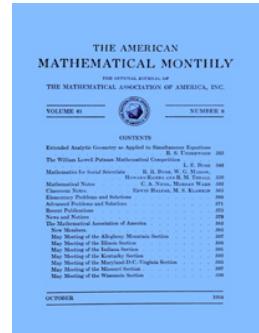
J. C. POLLEY, *Secretary*

THE MAY MEETING OF THE KENTUCKY SECTION

The annual meeting of the Kentucky Section of the Mathematical Association of America was held at the University of Louisville, Louisville, Kentucky, on May 9, 1953. Professor W. L. Moore, Chairman of the Section, presided at the morning and afternoon sessions.

Fifty-seven persons were present, including the following thirty-eight members of the Association:

H. H. Berry, J. M. Boswell, M. C. Brown, W. M. Bullitt, Esther A. Compton, J. B. Cornelison, H. H. Downing, R. I. Fields, Clarence Ford, A. W. Goodman, Reverend H. H. Gottbrath, Beulah Graham, Charles Hatfield, Aughtum S. Howard, G. B. Huff, Tadeusz Leser, A. G. McGlasson, D. G. Miller, W. L. Moore, R. S. Park, W. H. Pell, Sallie E. Pence, D. W. Pugsley, V. Elise Qualls, G. G. Roberts, W. J. Robinson, F. E. Ross, J. H. Simester, Sister M. Rosalin, Sister Mary Charlotte, R. H. Sprague, Guy Stevenson, R. P. Tapscott, J. T. Vallandingham, J. A. Ward, R. H. Wilson, T. M. Wright, W. M. Zaring.



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The May Meeting of the Indiana Section

J. C. Polley (Secretary)

To cite this article: J. C. Polley (Secretary) (1954) The May Meeting of the Indiana Section, *The American Mathematical Monthly*, 61:8, 591-592, DOI: [10.1080/00029890.1954.11988525](https://doi.org/10.1080/00029890.1954.11988525)

To link to this article: <https://doi.org/10.1080/00029890.1954.11988525>



Published online: 13 Mar 2018.



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in terms of continuity, differentiability, and integrability. Relations between circular, hyperbolic, and parabolic functions are pointed out in terms of the particular parameters involved.

A. WAYNE McGAUGHEY, *Secretary*

THE MAY MEETING OF THE INDIANA SECTION

The thirty-first annual meeting of the Indiana Section of the Mathematical Association of America was held at Rose Polytechnic Institute, Terre Haute, Indiana, on May 8, 1954. Two sessions were held at which Professor C. P. Sousley of Rose Polytechnic Institute, Chairman of the Section, presided.

There were fifty-one in attendance including the following thirty-six members of the Association:

H. W. Alexander, W. C. Arnold, A. P. Boblett, Stanley Bolks, G. E. Carscallen, W. W. Chambers, K. W. Crain, D. E. Deal, M. W. DeJonge, W. E. Edington, P. D. Edwards, R. E. Ekstrom, H. E. H. Greenleaf, J. R. Hadley, J. W. Hamblen, Ralph Hull, E. L. Klinger, L. H. Lange, G. T. Miller, Vera T. Morris, P. A. Nurnberger, Gloria Olive, T. P. Palmer, J. C. Polley, Tibor Rado, R. M. Ross, A. R. Schmidt, M. E. Shanks, W. O. Shriner, Aubrey H. Smith, C. P. Sousley, Anna K. Suter, R. O. Virts, M. S. Webster, K. P. Williams, G. N. Wollan.

The following officers were elected: Chairman, Professor H. W. Alexander, Earlham College; Vice-Chairman, Mr. R. O. Virts, Central High School, Fort Wayne, Indiana.

Professor P. D. Edwards of Ball State Teachers College reported that the Committee on Awards had awarded Association medals to five high school seniors on the basis of excellence in mathematics demonstrated in the Indiana Science Talent Search competition.

Professor Edwards also reported on the results of a study of mathematical preparation for college in Indiana, Michigan, and Illinois in which he, representing the Indiana Section, had collaborated with Professor P. S. Jones of the University of Michigan and Professor B. E. Meserve of the University of Illinois. A report on the study had been published under the heading, "Mathematical Preparation for College," in *The Mathematics Teacher*, Vol. XLV, May, 1952.

In accordance with a recent suggestion of the Board of Governors that the Section Governor be made an officer of the Section, the Constitution was amended so as to include the Section Governor as a member of the Executive Committee.

Professor L. H. Lange reported on the mathematics competition for undergraduate students in Indiana schools which has been sponsored in recent years by Valparaiso University. Following the discussion, and in part on his suggestion, a motion was passed instructing the chairman to appoint a committee to study the value of, need for, and interest in such a competition, and consider the desirability that the Section assume its sponsorship.

The following papers were presented:

1. *Global structure of the family of integral curves of differential equations*, by

Professor M. E. Shanks, Purdue University.

The speaker discussed, in an intuitive way, the problem of topologizing the integral curves of the system $\dot{x} = f(x, y)$, $\dot{y} = g(x, y)$. When the domain of the functions f and g is a closed rectangle containing no critical point of the system, then the natural topology on the integral curves gives a dendrite. Some special curves were considered and the fact noted that the presence of limit cycles renders such topologization impossible. Mention was made of the recent work of L. Markus, in which the notion of separatrix is fundamental, and its relation to the above problem.

2. A note on the triangular inequality, by Professor Gloria Olive, Anderson College.

The triangular inequality was discussed from the standpoint of the various mathematical topics it can motivate in an undergraduate seminar on this subject. The inequality was taken from one-dimensional real space into Hilbert space; on the way, a brief geometrically motivated proof, readily extended to n -dimensional space, was presented.

3. An algebraic proof of the central limit theorem, by Professor H. W. Alexander, Earlham College.

The usual proof of the central limit theorem is based on the use of moment generating functions, a device which properly belongs in graduate mathematics. The present proof makes use of the multinomial theorem, and in this connection introduces the idea of *similar terms*, that is, terms which have the same exponents in a different order. Expressions are obtained for the higher moments of the quantity $Y_n = n^{-1/2}(X_1 + X_2 + \dots + X_n)$, where X_1, X_2, \dots, X_n are from a common population with zero mean. The moments are shown to approach those of the normal distribution as $n \rightarrow \infty$.

4. Continuity and discontinuity in analysis and geometry, by Professor Tibor Rado, Ohio State University. (By invitation.)

Professor Rado discussed a series of examples of discontinuous functions and functionals, selected from various areas in analysis and geometry, which may be used in the classroom to throw more light upon the concept of continuity itself.

5. An application of geometric series with two ratios, by Professor L. H. Lange, Valparaiso University.

A geometric series with two ratios converges under certain conditions and the problem of finding these conditions and the resulting sum was solved by the author subsequent to its statement by F. Watkins as E 981 in this MONTHLY. He had found, and here discussed, an application of this type of series to a problem of obscure origin: that about the bird which flies back and forth between two cars which are following a crash course. Even when generalized this problem has a trivial solution and he is searching for an application to a problem not admitting the trivial solution.

6. Nomography from the similar triangle viewpoint, by Professor T. P. Palmer, Rose Polytechnic Institute.

The determinantal method of proof usually employed to establish the validity of nomographic techniques obscures the simplicity of the basic ideas in the usual alignment charts. This paper develops the parallel-line type, the concurrent-line type, and the N type, employing nothing more advanced than the properties of similar triangles. It also develops the two-parallel-line-and-one-curve type, in this case with the aid of elementary analytic geometry. The improved simplicity should render nomographic methods accessible to many who have previously avoided them.

J. C. POLLEY, *Secretary*



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The May Meeting of the Indiana Section

J. C. Polley (Secretary)

To cite this article: J. C. Polley (Secretary) (1955) The May Meeting of the Indiana Section, *The American Mathematical Monthly*, 62:8, 613-615, DOI: [10.1080/00029890.1955.11988702](https://doi.org/10.1080/00029890.1955.11988702)

To link to this article: <https://doi.org/10.1080/00029890.1955.11988702>



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A mathematical model is constructed which is intended to characterize the mechanical behavior of a pre-sintered powdered metal. Suitable plastic potential surfaces are discussed and the corresponding stress-strain laws derived. Uniqueness theorems and minimum principles are established.

2. *An experiment in probability*, by Professor Emeritus E. A. Whitman, Carnegie Institute of Technology.

In this paper the author shows one arrangement of successes where the probability of success is known and another arrangement of successes where the probability of success is determined experimentally. In both cases the interest is in the distribution of successes that are relatively infrequent.

3. *Symposium on automatic digital computers.*

High speed electronic computers are being more and more widely used to solve both scientific and industrial problems. The following three papers outlined some of the methods currently used in preparing problems for high speed computation:

(1) *Basic programming*, by Dr. Ruth Goodman,

(2) *Automatic coding*, by Dr. D. H. Shaffer,

(3) *Numerical integration*, by Dr. Morris Ostrofsky,

staff members of the Research Laboratory, Westinghouse Electric Corporation, Pittsburgh, Pennsylvania.

L. T. MOSTON, *Secretary*

THE MAY MEETING OF THE INDIANA SECTION

The thirty-second annual meeting of the Indiana Section of the Mathematical Association of America was held at Butler University, Indianapolis, Indiana, on May 7, 1955. Two sessions were held at which Professor H. W. Alexander of Earlham College, Chairman of the Section, presided.

There were 60 in attendance, including the following 52 members of the Association:

H. W. Alexander, W. C. Arnold, Juna L. Beal, L. G. Black, A. P. Boblett, Stanley Bolks, C. F. Brumfiel, G. E. Carscallen, W. W. Chambers, K. W. Crain, H. E. Crull, M. W. DeJonge, W. E. Edington, P. D. Edwards, C. B. Gass, E. L. Godfrey, S. H. Gould, G. H. Graves, Ralph Hafner, H. H. Hartzler, Ralph Hull, H. L. Hunzeker, M. W. Keller, E. L. Klinger, Florence Long, Gladys B. McColgin, D. M. Mesner, G. T. Miller, Vera T. Morris, J. E. Mueller, R. H. Oehmke, Theresa M. C. Oehmke, Gloria Olive, C. C. Oursler, P. W. Overman, T. P. Palmer, J. C. Polley, D. H. Porter, J. N. Rogers, R. M. Ross, A. R. Schmidt, K. J. Sidebottom, Sister Gertrude Marie, C. P. Sousley, Anna K. Suter, R. O. Virts, M. S. Webster, K. P. Williams, Herbert Wolf, Elizabeth S. Wolf, H. E. Wolfe, G. N. Wollan.

The following officers were elected: Chairman, Mr. R. O. Virts, Central High School, Fort Wayne, Indiana; Vice-Chairman, Professor C. F. Brumfiel, Ball State Teachers College; Secretary-Treasurer, Professor J. C. Polley, Wabash College.

Both sessions were held in the Holcomb Observatory, recently constructed and in use this year for the first time. Professor G. C. McVittee, Director of the Observatory at the University of Illinois, was guest speaker for the hour lecture. The title of the lecture was: *Why should an astronomer study relativity?*

Professor H. E. Crull of Butler University gave a planetarium demonstration following the lecture.

Professor P. D. Edwards, chairman of the Committee on Awards, reported that four Association medals had been awarded for high mathematical achievement in the Indiana Science Talent Search.

The following papers were presented:

1. *Some elementary properties of bonding mappings*, by Professor R. H. Oehmke, Butler University.

In any non-associative algebra A of characteristic not 2, with a subspace S closed under the operation $(x, y) = \frac{1}{2}(xy + yx)$, $U(S)$ denotes the subspace generated by all elements $xy - yx$ for x and y in S . If T is any linear mapping from $U(S)$ into S , a multiplication $x \circ y$ can be defined in S as $x \circ y = \frac{1}{2}(xy + yx) + (xy - yx)T$. Thus a new algebra $B(A, T)$ is defined which is in the same vector space as S and is closed under the product $x \circ y$. This algebra is said to be *bonded* to A by the *bonding mapping* T . The behavior of associative, Jordan, Lie, and power-associative algebras under a bonding mapping was examined. Such tools as ideals, idempotents, derivations, etc. used for the study of the structure of algebras were also examined.

2. *The mathematical theory of the Hatchet Planimeter*, by Professor P. D. Edwards, Ball State Teachers College.

The March 1954 issue of *The Professional Geographer* contained a short description of the "Hatchet Planimeter" by R. L. Williams. The mathematical theory was not given. The instrument has been used to a limited extent by cartographers and others since its description by Prytz in 1889. In this paper the mathematical theory is presented and comments made on the degree of accuracy to be expected.

3. *A summary of integral methods*, by Professor T. P. Palmer, Rose Polytechnic Institute.

Integration methods can be summarized under six topics: (1) the integral of $u^n du$, with $n = -1$ as a special case; (2) a collection of eight exact differentials (exponential and trigonometric; eleven, if including hyperbolic functions); (3) integration by parts; (4) substitution (chiefly trigonometric); (5) partial fractions; and (6) trigonometric identities. The last four topics are not really calculus, but provide ways of rearranging so that the first two topics apply. The only differential included which is not familiar from differential calculus is $d \ln (\sec x + \tan x) = \sec x dx$. By these methods, any form whose integral can be expressed in elementary functions can be integrated easily without reference to tables.

4. *Some embedding theorems for incidence matrices*, by Professor D. M. Mesner, Purdue University.

To a given incidence matrix A , matrices B , C , and D are to be adjoined so that

$$\begin{pmatrix} A & B \\ C & D \end{pmatrix}$$

is an $m \times n$ incidence matrix with equal row totals T and equal column totals U . The required numbers of 0's and 1's in each row of B and column of C , and in the entire block D , are easily computed. It is obviously necessary for the existence of B , C , and D that these numbers be non-negative, and that $mT = nU$. These are shown to be sufficient conditions as well. This generalizes a theorem of Ryser (*Proc. Amer. Math. Soc.*, vol. 2, 1951, 550-552).

5. *Some applications of evenly convex sets*, by Dr. J. R. Blum, Indiana University, introduced by Professor K. P. Williams.

A convex set in finite-dimensional Euclidean space is called evenly convex (W. Fenchel, *A remark on convex sets and polarity*, Comm. du sem. math. de L'un. de Lund, tome supp., 1952) if it is the intersection of a family of open half-spaces. Criteria are given for a convex set to be evenly convex, and for a vector to belong to an evenly convex set. These are applied to obtain an existence criterion for unbiased tests of finite statistical hypotheses.

6. *Mohr space representation of algebraic equations*, by Professor M. O. Peach, University of Notre Dame.

The Mohr circle construction used by engineers to represent the stress tensor is extended to space of higher dimensions, hence to square symmetric matrices of arbitrary rank. It is then generalized to represent non-symmetric matrices. A step by step method for diagonalizing such matrices is interpreted geometrically, both for the case of real and the case of complex characteristic roots. The well known procedure for writing the matrix for which a given algebraic equation is the characteristic equation provides the connecting link whereby any algebraic equation can be given a unique geometrical representation in Mohr space.

7. *The structure of commutative semigroups*, by Professor R. E. MacKenzie, Indiana University, introduced by Professor H. E. Wolfe.

By suitably formulating the basic structure theorems of commutative rings it is possible to carry through their demonstration without the use of the operation of addition. These theorems then become statements about the structure of commutative semigroups. The formulation is such that the theorems on rings may then be obtained by assuming that the semigroup is a ring.

J. C. POLLEY, *Secretary*

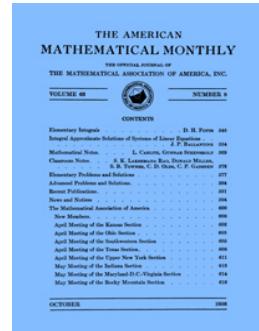
THE MAY MEETING OF THE ILLINOIS SECTION

The thirty-fourth annual meeting of the Illinois Section of the Mathematical Association of America was held at Monmouth College, Monmouth, Illinois, on May 13 and 14, 1955. Professor Rothwell Stephens, Chairman of the Section, presided at all sessions.

There were 47 in attendance, including the following 37 members:

Beulah M. Armstrong, H. G. Ayre, J. W. Beach, H. R. Beveridge, D. R. Bey, A. H. Black, A. O. Boatman, H. A. Bott, Joseph R. Brown, L. J. Burton, Paul Cramer, Allen Fenstermacher, S. R. Filippone, A. E. Gault, A. E. Hallerberg, M. C. Hartley, F. E. Hohn, M. R. Kenner, E. C. Kiefer, Rose Lariviere, A. O. Lindstrum, Jr., Saunders MacLane, W. G. Madow, W. C. McDaniel, A. W. McGaughey, E. B. Miller, M. G. Moore, C. E. Moulton, T. E. Rine, L. A. Ringenberg, W. C. Ross, Jr., M. Anice Seybold, W. H. Spragens, Jr., Rothwell Stephens, Gabriel Tsiang, L. L. Wimp, Alice K. Wright.

At the business meeting on Friday afternoon the following officers were elected for the coming year: Chairman, Professor H. R. Beveridge, Monmouth College; Vice-Chairman, Professor L. A. Ringenberg, Eastern Illinois State College; Secretary-Treasurer, Professor A. W. McGaughey, Bradley University. Professor Joseph Stipanowich reported on the work of the "Committee on Contests and Awards" stating that the number of high schools participating increased over that of the preceding year by almost 80%. Professor A. O. Lindstrum, Jr., reported on the work done by the "Committee on the Strengthening of the Teaching of Mathematics" and proposed several resolutions which were adopted.



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The May Meeting of the Indiana Section

J. C. Polley (Secretary)

To cite this article: J. C. Polley (Secretary) (1956) The May Meeting of the Indiana Section, *The American Mathematical Monthly*, 63:8, 613-614, DOI: [10.1080/00029890.1956.11988875](https://doi.org/10.1080/00029890.1956.11988875)

To link to this article: <https://doi.org/10.1080/00029890.1956.11988875>



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THE MAY MEETING OF THE INDIANA SECTION

The thirty-third annual meeting of the Indiana Section of the Mathematical Association of America was held jointly with the Indiana Council of Teachers of Mathematics at Wabash College, Crawfordsville, Indiana, on May 5, 1956. Professor R. O. Virts of Central High School and the Purdue University Center at Fort Wayne, Chairman of the Section, presided at the general session and at the sectional meetings of the Association which followed.

Professor K. O. May, Chairman of the Mathematics Department of Carleton College, guest speaker for the hour lecture, addressed the general session on the topic, "A Modern Introduction to Mathematics."

There were 133 in attendance including 51 members of the Association.

The following officers were elected: Chairman, Professor C. H. Brumfiel, Ball State Teachers College; Vice-Chairman, Professor C. B. Gass, DePauw University; Secretary-Treasurer, Professor J. C. Polley, Wabash College.

Professor P. D. Edwards, Chairman of the Committee on Awards, reported that five Association medals had been awarded during the year for high mathematical achievement in the Indiana Science Talent Search.

The following short papers were presented:

1. *Non-linear recurrence relations for classical orthogonal polynomials*, by Professor M. S. Webster, Purdue University.

Some of the known and some new non-linear relations involving Hermite, generalized Laguerre, and ultraspherical polynomials were given. A typical proof was presented showing that such a relation essentially characterizes polynomials of the type given.

2. *A geometry experiment*, by Professor C. F. Brumfiel, Ball State Teachers College, and Professor M. E. Shanks, Purdue University, presented by Professor Shanks.

The purpose of this paper was to call the attention of college teachers to shortcomings in high school geometry texts and to encourage the writing of better texts. Defects in Euclid's geometry have long been known but current texts do not remove these flaws. In fact, they add errors of their own. Besides being incomplete, these texts are lacking in logic and give as postulates what are really theorems or definitions. A critique of Euclid's postulates was given and Hilbert's postulates were described briefly. A modified version of Hilbert's postulates was described, a version which is being taught at the Burris High School in Muncie, Indiana in a course for which the textual material has been prepared by the authors of the paper.

3. *Discontinuities for the classroom*, by Professor H. L. Hunzeker, DePauw University.

Graphical illustrations of discontinuous functions for classroom use were obtained from considering common machines as mathematical systems.

4. *An operator identity for $(D^2+a^2)y=f(x)$* , by Professor R. E. MacKenzie, Indiana University, introduced by Professor H. E. Wolfe.

A solution of the differential equation $(D^2+a^2)y=f(x)$ by quadratures was effected by means of an operator identity using trigonometric functions.

5. *On a function defined by means of an infinite radical*, by Professor G. N. Wollan and Mr. D. M. Mesner, Purdue University Center, Fort Wayne, presented by Professor Wollan.

If $0 < x \leq 1$, then x has a non-terminating binary representation $x = a_1 a_2 \dots a_n \dots$. Let $\alpha_n = (-1)^{a_n}$ and $f_n(x) = \sqrt{k + \alpha_1 \sqrt{k + \alpha_2 \sqrt{k + \dots + \alpha_n \sqrt{k}}}}$, $n = 1, 2, 3, \dots$, and let I denote the interval $0 < x \leq 1$. When $k > 2 + \sqrt{2}$, then $\lim_{n \rightarrow \infty} f_n(x)$ exists and is real for every x in I and this defines a function $f(x) = \lim_{n \rightarrow \infty} f_n(x)$. This function is discontinuous at every point in I having a terminating binary representation and is continuous elsewhere in I . The function is not monotone in any sub-interval of I and yet has a derivative equal to zero at each point of a dense set of points of I and has a left derivative equal to zero at every point of discontinuity.

J. C. POLLEY, *Secretary*

THE MAY MEETING OF THE MARYLAND-DISTRICT OF COLUMBIA-VIRGINIA SECTION

The spring meeting of the Maryland-District of Columbia-Virginia Section of the Mathematical Association of America was held at the U. S. Naval Academy, Annapolis, Maryland, on May 5, 1956. Professor F. E. Johnston, Chairman of the Section, presided at the morning and afternoon sessions.

There were 99 persons in attendance, including 75 members of the Association.

The following officers were elected to serve for a period of one year: Chairman Professor R. C. Yates, College of William and Mary; Vice-Chairmen, Professor J. E. Freund, Virginia Polytechnic Institute and Professor D. B. Lloyd, District of Columbia Teachers College; Secretary, Professor R. P. Bailey, U. S. Naval Academy; Treasurer, Professor T. W. Moore, U. S. Naval Academy.

The following papers were presented.

1. *The coloring of maps*, by Professor R. W. Rector, U. S. Naval Academy.

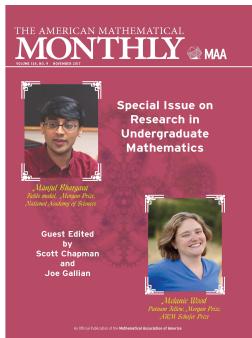
The speaker presented a historical survey of the four color problem with particular attention to the method of Birkhoff and Lewis for constrained chromatic polynomials for the n -ring. Certain steps were indicated leading to the solution of the constrained chromatic polynomials of the seven-ring.

2. *Aliquot sequences (preliminary report)*, by Mr. G. A. Paxson, U. S. Army, Fort Meade, Maryland.

Let $S(n) = \sum_{d|n} d$, $0 < d < n$. $S(n)$ is called the sum of the *aliquot parts* of n . Put $S^0(n) = n$, $S^1(n) = S(n)$, and $S^{k+1}(n) = S(S^k(n))$. The infinite sequence $n, S(n), S^2(n), \dots$ is called the *aliquot sequence* with leader n .

A sequence is *eventually periodic* if any term of the sequence recurs.

Conjecture: Every sequence is eventually periodic. Every sequence examined for this property, except a few, displayed it upon computation of a sufficient number of terms. The few involve terms of great size, rendering continued hand computation impracticable. All sequences with leaders $n \leq 10,000$ are being computed until discovered to be periodic or until a term with more than 20 digits is reached. Computation is being done on the IBM Type 650 Magnetic Drum Data-Processing Machine at the Watson Scientific Computing Laboratory, 612 West 116th Street, New York, New York.



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The May Meeting of the Indiana Section

J. C. Polley (Secretary)

To cite this article: J. C. Polley (Secretary) (1957) The May Meeting of the Indiana Section, *The American Mathematical Monthly*, 64:8P1, 619-621, DOI: [10.1080/00029890.1957.11989062](https://doi.org/10.1080/00029890.1957.11989062)

To link to this article: <https://doi.org/10.1080/00029890.1957.11989062>



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Mine is a voice "crying in the wilderness", the wilderness of the "wastelands" of American Education. My plea is that we rise up and cut the unimportant and repetitive from our high school mathematics courses and replace them by those topics which lead to a better understanding of college mathematics. Also, that high school mathematics teachers be told what (and in many cases how) to teach these important topics. In consequence, 84 topics desirable for prospective college students were proposed.

6. *Logistics of the computation*, by Dr. R. C. Bollinger, Westinghouse Research Laboratories.

It is the purpose of the talk to try to make clear to those having no previous familiarity with digital computing machines just what one must do to plan a computer program. The various ideas and devices necessary to the planning are illustrated by considering the programming of an actual computer routine to compute values of the Riemann Zeta function. A flow chart which expresses the organization of the computation is constructed in this, the logical analysis, stage of the planning.

7. *Arithmetic, bit by bit*, by Mrs. Aiko Hormann, Westinghouse Research Laboratories, introduced by Dr. R. C. Bollinger.

After a problem is programmed for the machine, it must be further broken down into simple arithmetic operations and then translated into machine code. This translation is comparable to the translation from one human language to another. The similarity and also the difference between the two types of translation are discussed with a few illustrations.

8. *Why doesn't it work?*, by Dr. H. C. Rice, Westinghouse Research Laboratories, introduced by Dr. M. Ostrofsky.

After a suitable emphasis on the inevitability of mistakes in programming a problem for a computer, a survey is made of the kinds of mistakes which can occur, their effect on the behavior of the computer when the program is run, and some of the techniques for finding and correcting them.

I. D. PETERS, *Secretary*

THE MAY MEETING OF THE INDIANA SECTION

The thirty-fourth annual meeting of the Indiana Section of the Mathematical Association of America was held at Purdue University, Lafayette, Indiana on May 11, 1957. Professor C. F. Brumfiel of Ball State Teachers College, Chairman of the Section, presided at both morning and afternoon sessions. There were 77 in attendance including 54 members of the Association.

The following officers were elected: Chairman, Professor C. B. Gass, DePauw University; Vice-Chairman, Professor G. N. Wollan, Purdue University Center, Fort Wayne; Secretary-Treasurer, Professor J. C. Polley, Wabash College.

Chairman Brumfiel announced that the Committee on Awards had awarded three Association medals during the year for high mathematical achievement in the Indiana Science Talent Search.

It was voted that a fall meeting be held this year on October 18 in joint session with the Mathematics Section of the Indiana Academy of Science.

Professor A. W. Tucker of Princeton University, National Lecturer for the Association, gave the invited hour address on the topic, "New Patterns in Mathematical Education."

The following short papers were presented:

1. *Mathematical instruction in Dutch high schools*, by Professor Philip Dwinger, Purdue University.

Some aspects of the teaching of mathematics in Dutch high schools were discussed, such as the subjects taught and the programs for the several final examinations. In addition, attention was called to an important report in 1954 of a committee of the Association of Mathematics Teachers, which, among other things, recommended the introduction of statistics into the program and an intuitive course in plane geometry to precede the regular course in that subject.

2. The Council, the Association, and the Society, by Professor C. F. Brumfiel, Ball State Teachers College.

Mathematicians recognize the need for a reorganization of high school mathematics. The content of current texts bears little relation to modern mathematics. These texts abound in gross errors, and an archaic terminology is employed. The organization which sees most clearly the need for the development of a new high school curriculum is the Council, and to effect a change the support of both the Association and the Society is needed. Changes in high school must match the changes that are occurring in colleges and universities. It is to be hoped that these three organizations will, in cooperation, persuade some of the best mathematicians to write texts on the high school level.

3. Problems of criteria and evaluation, by Professors M. W. Keller and C. L. Kaller, Purdue University, presented by Professor Keller.

The authors discussed some of the problems inherent in obtaining criteria for admission to and prognosis of success in graduate courses and teaching for mature individuals whose formal training was obtained approximately thirty years ago. A brief report on earlier studies was supplemented by observations based on the current experience of the authors.

4. Classroom administration, by Professor G. H. Graves, Valparaiso University.

Since the purposes of the class meeting are to further the student's mastery of material and to increase his ability to gain returns from study, the first essential is to see that his questions are answered, ordinarily by other students. The advantages gained by seat work, board work, and outside work handed in were contrasted. The author felt that note-taking should be discouraged since it distracts from the mental concentration required to take greatest advantage of class work.

5. Proper cyclic elements, fine cyclic elements, and Lebesgue area, by Professor C. J. Neugebauer, Purdue University, introduced by the Secretary.

Let Q be a unit square in E_2 , and, for (T, Q) a continuous mapping from Q into E_3 , let $(T, Q) = lm$, $m: Q \rightarrow M$, $l: M \rightarrow E_3$ be a monotone-light factorization. For C a proper cyclic element of M , let r_C be the monotone retraction from M onto C . For $L(T, Q)$, the Lebesgue area of (T, Q) , the following cyclic additivity formula subsists:

$$(1) \quad L(T, Q) = \sum L(r_C m, Q), \quad C \subset M \quad (\text{T. Rado, } Length \text{ and Area}, \text{ Amer. Math. Col. Publ., 30, 1948}).$$

The formula (1) has been generalized and extended by the introduction of a *fine cyclic element* of a mapping (T, J) , where J is a closed finitely connected Jordan region (L. Cesari, *Fine cyclic elements of surfaces of the type γ* , Riv. Mat. Univ. Parma). If J is a 2-cell, the fine cyclic elements coincide with proper cyclic elements. In the other cases a fine cyclic element constitutes a suitable decomposition of a proper cyclic element. The above concept of a fine cyclic element can be extended to Peano spaces, and fine cyclic additivity theorems similar to those in paper by E. J. Mickle and T. Rado (*On cyclic additivity theorems*, Trans. Amer. Math. Soc., vol. 66, 1949, pp. 347-365) can be established.

6. Critical thinking values in introductory modern mathematics, by Sister Gertrude Marie, Marian College.

Elementary phases of number theory, group theory, the algebra of classes, and modern geometries are cited as source materials for basic experience with definition, undefined terms, relation-

ships expressed in postulates, and theorems resulting from deductive reasoning. The nature of inductive thinking is exemplified by statistical inference. Both induction and deduction are shown to fill important roles in scientific thought, while, in the symbolic formulation of logic, mathematics is identified with critical thinking in its purest interpretation.

7. Do machines think?, by Professor R. E. Baer, Purdue University, introduced by Professor Arthur Rosenthal.

Reference is made to papers under similar or related title by Turing, Wilkes, Oettinger, *et al.*, as well as the recent work of Hagelbarger, and Simon and Newell, and that of the Purdue Computation Laboratory. A thinking-like behavior on the part of the universal computer, barring metaphysical but not metamathematical considerations, requires emulation by the machine of both inductive and deductive behavior. The increasing degree of success of machine performance in the two directions is discussed.

8. Order among complex numbers, by Mr. Merl Kardatzke, student at Anderson College, introduced by Professor Gloria Olive.

This paper first orders complex numbers by a rule which does not seem to lend itself to a one-to-one correspondence between complex numbers and real numbers. In search for this relationship an analytic expression is found which can order a special set called "semi-countable complex numbers". Finally, binary numbers are used to construct a function which sets up the correspondence which is sought. In conclusion the concept of order is extended to n -dimensional space.

9. An experiment in teaching calculus over closed-circuit television, by Professor John Dyer-Bennet, Purdue University, introduced by Professor Arthur Rosenthal.

This paper is a brief report of an experiment conducted at Purdue University, comparing the effectiveness of teaching calculus to small groups over closed-circuit television with that of teaching large groups in lectures. Although the results have not yet been analyzed statistically, they appear to indicate that if effectiveness is measured by the sort of examination commonly used to determine grades, the two methods are about equally good.

10. The differential, by Professor H. L. Hunzeker, DePauw University.

The implications arising from the existence of differentials for real functions of one and of several real variables as well as for functions of a complex variable were summarized. An application for the differential of a function of a complex variable was shown in a rather direct proof of the Cauchy Integral Formula.

11. Some additional remarks on a function defined by means of an infinite radical, by Professor G. N. Wollan and Mr. D. M. Mesner, Purdue University Center, Fort Wayne, presented by Professor Wollan.

This paper presents some additional properties of the function $f(x)$ defined on $0 < x \leq 1$ by the relation $f(x) = \lim_{n \rightarrow \infty} f_n(x)$ where

$$\begin{aligned}f_1(x) &= \sqrt{k + \alpha_1 \sqrt{k}}, \quad f_2(x) = \sqrt{k + \alpha_1 \sqrt{k + \alpha_2 \sqrt{k}}}, \\f_n(x) &= \sqrt{k + \alpha_1 \sqrt{k + \cdots + \alpha_n \sqrt{k}}} \text{ with } n \text{ nested root signs,}\end{aligned}$$

$n = 1, 2, \dots$, and $\alpha_n = (-1)^{a_n}$ where a_n is the n th digit in the nonterminating binary representation of x . (See this MONTHLY, vol. 63, 1956, p. 614.) The author shows that when $k > 2 + \sqrt{2}$, although the function has a denumerably infinite set of discontinuities and is not monotone in any subinterval, it is of bounded variation; although it has a value at each point of the interval with $f(x_1) \neq f(x_2)$ when $x_1 \neq x_2$, yet the set of values of the function is of measure zero. Furthermore the derivative exists almost everywhere and whenever it exists its value is zero, but there is a non-denumerable set of points (of measure zero) at which the derivative does not exist.

J. C. POLLEY, *Secretary*

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The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The October Meeting of the Indiana Section

J. C. Polley (Secretary)

To cite this article: J. C. Polley (Secretary) (1958) The October Meeting of the Indiana Section, The American Mathematical Monthly, 65:5, 388-389, DOI: [10.1080/00029890.1958.11989205](https://doi.org/10.1080/00029890.1958.11989205)

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THE OCTOBER MEETING OF THE INDIANA SECTION

A joint meeting of the Indiana Section of the Mathematical Association of America and the Mathematics Division of the Indiana Academy of Science was held at DePauw University, Greencastle, Indiana, on October 18, 1957. Professor I. W. Burr, Chairman of the Mathematics Division of the Academy, presided.

There were 69 in attendance including 37 members of the Association.

The following papers were presented:

1. *The mathematics of the future*, by Professor P. D. Edwards and Professor C. F. Brumfiel, Ball State Teachers College.

Professor Edwards stressed the increasing importance of having high school teachers of mathematics who are much more thoroughly trained in advanced mathematics than was considered necessary a relatively few years ago. This applies not only to the traditional topics needed by the engineer and the physical scientist but also to the needs of workers in other fields. It was pointed out that very definite improvements in the teachers' preparation may be made by drastic changes in the content of high school mathematics. Professor Brumfiel made a progress report on an experimental program now being supervised by Ball State which was made possible by a grant from the National Science Foundation.

2. *A characterization of n -adic equivalence relations*, by Professor J. L. Lawrence, Wabash College and International Business Machines, introduced by the Secretary.

The concepts of symmetry, transitivity, composition, and equivalence associated with dyadic relations were generalized to apply to the n -adic case. In the generalized scheme, symmetry and transitivity persist as necessary and sufficient conditions for an n -adic relation to be an equivalence relation. Furthermore, as in the dyadic case, an n -adic relation is transitive if and only if the relation contains the composition of the relation with itself.

3. *The concept of surface integral*, by Mr. L. H. Turner, Purdue University, introduced by the Secretary.

A continuous parametric surface (T, A) is a continuous mapping T from a subset A of E_2 into three space E_3 , $p = T(w)$, $w = (u, v) \in A$, $p = (x, y, z) \in E_3$. The usual definition of area in terms of the Jacobians of the mapping is inadequate in modern analysis. An adequate definition was given by Lebesgue in terms of sequences of polyhedral mappings which approach the original mapping. When the area is finite, four measures ϕ , V_1 , V_2 , V_3 may be defined by means of these sequences on a certain ring of Borel subsets of A such that V_1 , V_2 , and V_3 are absolutely continuous with respect to ϕ . The Radon-Nikodym derivatives $\theta_1(w) = dV_1/d\phi$, $\theta_2(w) = dV_2/d\phi$, $\theta_3(w) = dV_3/d\phi$ exist and satisfy $\theta_1^2 + \theta_2^2 + \theta_3^2 = 1$ a.e. (ϕ). The vector $\theta(w) = (\theta_1, \theta_2, \theta_3)$ may be thought of as the directional normal to the surface (T, A) at $T(w)$. Then if $D = \{(\theta_1, \theta_2, \theta_3) : \theta_1^2 + \theta_2^2 + \theta_3^2 = 1\}$ and $f(x, y, z, \theta_1, \theta_2, \theta_3)$ is any function which is Borel measurable and bounded on $T(A) \times D$, the integral $H(T, A, f) = (A) \int f(T(w), \theta(w)) d\phi$ exists and is the integral of f over (T, A) .

4. *Periodic solutions of nonlinear differential equations*, by Professor W. R. Fuller, Purdue University.

In this paper, which was expository in nature, were indicated some types of nonlinear differential equations and systems of such equations, for which existence theorems for periodic solutions have been studied. This includes systems containing a small parameter, ϵ , which for $\epsilon = 0$ have periodic solutions. In particular the study of systems of the form $x + \sigma^2 x = f(x, t; \epsilon)$ where $\sigma^2 x$ and f are n -vectors has been very fruitfully attacked by a method of L. Cesari which has been applied to a wide class of problems by Cesari, Hale, Gambill, Bailey and the author (see, e.g., Atti Acad. Italia, vol. 11, 1940, pp. 633-692; Bull. AMS 60, 1954, pp. 64-66, 367; 62, 1956, p. 567; 63, 1957, p. 271).

5. *Localization experiment for teaching geometry*, by Professor A. D. Hummel, Ball State Teachers College, introduced by the Secretary.

A method of determining the x , y , and z coordinates of points within a body by means of X-rays was reviewed. Projected images of scales are used as measuring sticks in two radiographs. The source of the X-rays has different positions for the two radiographs. Elementary geometry is used to compute the coordinates of any point appearing in both. In the experiment described for teaching, a small source of visible light is substituted for the X-ray source. Data obtained from shadows is used to calculate the length of the object. Verification of the result by direct measurement should strengthen the students' faith in geometry.

6. *Undergraduate curricula—some brave experiments and cogent lessons*, by Professor A. E. Ross, University of Notre Dame.

There are many critical problems which confront one in the task of implementing an effective undergraduate program in mathematics. Today such a program must not only appeal to the people who have traditionally relied upon mathematical tools, but it must also appeal to the users of new mathematics, most of whom come from the humanities, from commerce, and from the "preprofessional" groups. The novelty of the new undergraduate curriculum lies not only in the new content but also in the growing recognition that mathematical manipulative skills alone do not develop the capacity for intelligent application nor do these skills alone justify considering mathematics as one of the liberal arts. To design a proper blending of the new and the old, of ideals and of skills, and to make this blend accessible to the very young brings us close to the fundamental questions in the art of communication. The purpose of this talk was to discuss and to illustrate some of these questions.

7. *A graphical solution for a particular finite series*, by Dr. R. H. L. Howe, Eli Lilly and Company, Lafayette, Indiana, introduced by the Secretary.

There are problems in engineering and the physical sciences which require the evaluation of y given as a finite series of the form $y = 1/x_1 + \dots + 1/x_n$, where x_1, \dots, x_n are positive or negative real numbers. Let $y = 1/R$. Then R can be found graphically using a simple geometric principle. When a large number of terms is involved, this graphical method is particularly time saving. It is thus very useful in checking problems such as those concerning resistance of resistors in parallel, capacity of condensers in series, focal length in optical systems, and total resistance or conduction coefficient of materials in heat transfer and transmission.

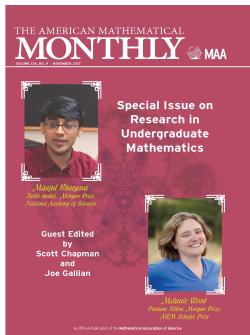
8. *On the inter-relationship of applications and mathematical research*, by Dr. K. L. Nielsen, U. S. Naval Avionics Facility, Indianapolis, Indiana.

Emphasizing the constant increase and breadth of scope in the utilization of mathematics in contemporary nonmathematical fields, the author concentrated primarily on the inter-relationship between mathematical research and some technological developments, electronic calculating machines, and the philosophy of education. He discussed the role of the mathematician in industry, industry's utilization of mathematics, the development of new mathematics, and the need for closer cooperation between the educators and those engaged in research and the application of mathematics.

J. C. POLLEY, *Secretary*

THE NOVEMBER MEETING OF THE NEW JERSEY SECTION

The second annual meeting of the New Jersey Section of the Mathematical Association of America was held at Fairleigh Dickinson University, Rutherford, New Jersey, on November 2, 1957. Dean A. E. Meder Jr., retiring Chairman of the Section, presided at the morning session; Dean C. W. Black, Fairleigh Dickinson University, presided at the luncheon and during the address by Dr. Morris Meister; and Professor B. E. Meserve, newly-elected Chairman of the Section, presided at the afternoon session. 104 persons registered.



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The May Meeting of the Indiana Section

J. C. Polley (Secretary)

To cite this article: J. C. Polley (Secretary) (1958) The May Meeting of the Indiana Section, *The American Mathematical Monthly*, 65:8P1, 656-658, DOI: [10.1080/00029890.1958.11990290](https://doi.org/10.1080/00029890.1958.11990290)

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- JOHN E. WOOD, M.A.(Longwood) Instr., Hampden Sydney College.
- ROY E. WORTH, Student, University of Georgia.
- JOHN W. WYMAN, Student, Olivet Nazarene College.
- EDWARD G. ZDINAK, M.S.(Pittsburgh) Grad. Student, University of Pittsburgh.

THE MAY MEETING OF THE INDIANA SECTION

The thirty-fifth annual meeting of the Indiana Section of The Mathematical Association of America was held at Ball State Teachers College, Muncie, Indiana, on Saturday, May 3, 1958. Professor C. B. Gass of DePauw University, Chairman of the Section, presided at both morning and afternoon sessions. There were 52 in attendance, including 39 members of the Association.

The following officers were elected: Chairman, Professor G. N. Wollan of Purdue University; Vice-Chairman, Professor K. H. Carlson of Valparaiso University; Secretary-Treasurer, Professor C. F. Brumfiel of Ball State Teachers College.

Professor Edwards, chairman of the Committee on Awards, announced that four Association Medals had been awarded this year to high school seniors exhibiting high mathematical achievement in the Indiana Science Talent Search program. The following motions were carried: (1) That the Section adopt the policy of holding a fall meeting in joint session with the Mathematics Division of the Indiana Academy of Science. (2) That the Section sponsor the administration in Indiana of the Annual High School Mathematics Contest which is sponsored nationally by the M.A.A. and the Society of Actuaries. (3) That a committee be appointed by the chairman to work with the Indiana Council of Teachers of Mathematics to lay down a plan for securing support for local institutes on the teaching of mathematics.

Professor R. M. Thrall of the University of Michigan gave the invited hour address on the topic, "Applications of Mathematics in the Social Sciences."

The following short papers were presented:

1. *Some remarks on the teaching of elementary algebra*, by Professor A. M. Yaqub, Purdue University.

In attempting to strengthen our undergraduate mathematics courses, the author proposed to combine *understanding* with techniques in the teaching of elementary algebra. In algebra, as in high school geometry, one would naturally begin with the axioms which the real numbers are supposed to satisfy, and from which the theorems are to be derived. These axioms include the usual axioms for a field. On the basis of these one could derive the familiar laws of signs. By assuming a few additional axioms one could then derive the laws of inequalities and the laws of exponents. This modest start would immediately indicate to the student the spirit of the axiomatic approach, and no doubt show him that algebra is every bit as suitable for axiomatic treatment as geometry. Moreover, this method allows the teaching of algebra as a *science* rather than as a collection of recipes together with some mystical laws.

2. *Dexinal gauges*, by Mr. Aaron Miller, 1415 W. 28th Street, Indianapolis, Indiana.

The stop to which the base 2 must be raised to produce a number k is called the dexinal gauge of k . Two numbers are dexinated by adding their gauges and are sindexinated by subtracting their gauges. A dextratio (dexine of a ratio) is the dexnum (dexine of the numerator) sindexed by the dexdenom (dexine of the denominator). A dextratio is reduced by taking the ratio of the logarithms to the base 2 of the dexnum and dexdenom. The equality of the two dextratios is called a poise and is the analogue of a proportion. The mean poisal is the analogue of the mean proportional. Employing these definitions, the author developed some theorems and presented several interesting applications in numerical computations.

3. *The seventeen ornamental groups*, by Professor H. W. Alexander, Earlham College.

The seventeen ornamental groups were discussed from the standpoint of (a) the classification of an actual design under one of these groups and (b) the representation of the groups by means of matrices. Other designs were examined.

4. *The sum of a particular series and the corresponding integral*, by Professor L. W. Stark, Butler University.

The analytic solution of the heat conduction equation is obtained by use of the Laplace transform and the convolution integral. One term in the solution is the cosine series

$$\sum_{n=1}^{\infty} [(-1)^{n-1} \cos(2n-1)y/(2n-1)^{2p-1}]$$

$p \geq 1$. Beginning with the result given by Bromwich for $p=1$, the method for obtaining the result for $p=2$ was given in detail and results were then stated for $p=3, 4, 5$. It was also established that the summations evaluated at $y=0$ are multiples of corresponding Euler numbers.

5. *A progress report on experimental work at Ball State Teachers College*, by Professor C. F. Brumfiel, Ball State Teachers College.

For the last three years an experimental geometry and algebra program has been tested in the Ball State laboratory school. Tenth grade geometry is treated rigorously in a course based upon a modified version of the Hilbert postulates. The algebra is a mild postulational treatment that covers most of the conventional topics of ninth grade algebra. During the past year teachers from Eastern Indiana schools, enrolled at Ball State in a National Science Foundation In-Service Institute, have taught the geometry experimentally. Under a continuation of this grant the experimental program will be continued and expanded to include the algebra in 1958-59.

6. *It's all in your mind*, by Professors J. E. Forbes and W. R. Fuller of Purdue University, presented by Professor Forbes.

This was a preliminary report on an experiment in commercial television in a series of weekly broadcasts of topics in mathematics. Many interesting points concerning the preparation and presentation of the programs and the methods used to enlist and maintain the interest of listeners were discussed.

7. *A report on the 1957 Summer Institute on Mathematics in the Social Sciences at Stanford University*, by Professors J. C. Polley, Wabash College, G. N. Wollan, Purdue University, and K. H. Carlson, Valparaiso University.

The subject was introduced by Mr. Polley with general remarks on the nature, the staff, and the organization of the institute. He stated that the institute had been sponsored by and financed by a grant from the Social Science Research Council for the purpose of acquainting college teachers of mathematics with the current applications of mathematics in the field of the social sciences. Attending members represented colleges of various types widely distributed over the country.

Drawing on the eight-weeks experience, Mr. Wollan emphasized the values of such institutes. He urged that efforts be made to promote setting some up on the local level.

In conclusion, Mr. Carlson discussed in some detail the conduct of the institute and the material presented by the various members of the staff.

J. C. POLLEY, *Secretary*

THE MAY MEETING OF THE MINNESOTA SECTION

The annual spring meeting of the Minnesota Section of the Mathematical Association of America was held on May 17, 1958 at St. John's University, Collegeville, Minnesota. Reverend Walbert Kalinowski, O.S.B., of St. John's University presided at the morning session. The section chairman, Professor O. E. Stanaitis of St. Olaf College, presided at the afternoon session. There were 53 persons registered, of whom 39 were members of the Association.

The following officers were elected to serve for the academic year 1958-1959: Chairman, Reverend Walbert Kalinowski, O.S.B., of St. John's University; Secretary, Professor F. L. Wolf of Carleton College; Members of the Executive Committee, Professor O. E. Stanaitis of St. Olaf College, Professor David Lewis of Hamline University and Remington-Rand Univac, and Professor James Serrin of the University of Minnesota.

At the business meeting, Professor J. M. H. Olmsted reported on the High School Mathematics Contest which was sponsored by the section in Minnesota this year. In this, the first year that the contest was given in Minnesota, it was very successful. The section owes many thanks to Professor G. K. Kalisch of the University of Minnesota and to the members of his High School Contest Committee for this success. Professor Leon Green of the University of Minnesota was appointed chairman of the High School Contest Committee for 1958-1959.

Professor F. L. Wolf reported for the Committee on High School-College Relations. Several proposals for the improvement of high school-college relations were made by the committee and motions from the floor were passed instructing the committee to proceed with implementation or further study of these.

The following papers were presented:

1. *Equations with trigonometric values as roots*, by Professor K. W. Wegner, Carleton College.

Sixty-four equations were presented, along with illustrations of their use in the classroom, as the only irreducible polynomial equations with integral coefficients and of degree two through seven whose roots are of the form $\pm \sin y$, $\pm \cos y$, $\pm \tan y$, $\pm \cot y$, $\pm \sec y$, or $\pm \csc y$, where y is a rational number of degrees.

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The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The November Meeting of the Indiana Section

Charles Brumfiel (Secretary)

To cite this article: Charles Brumfiel (Secretary) (1959) The November Meeting of the Indiana Section, *The American Mathematical Monthly*, 66:5, 444-445, DOI: [10.1080/00029890.1959.11989318](https://doi.org/10.1080/00029890.1959.11989318)

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REPORT OF THE TREASURER FOR THE YEAR 1958

Following is a summary of the report of Professor H. M. Gehman as Treasurer of the Association for the year 1958. The complete report has been approved by the Finance Committee and accepted by vote of the Board of Governors. Any member of the Association who wishes the complete report of the Treasurer may obtain it by writing to the Buffalo office of the Association.

There was a surplus of \$5,701 in the Current Fund of the Association for 1958. The balances in the regular funds of the Association have increased during 1958 except for the Chace Fund. The cost of printing Slaught Papers and the third edition of Professional Opportunities in Mathematics has caused a small decrease in this fund.

ASSETS OF THE ASSOCIATION	JANUARY 1, 1958	DECEMBER 31, 1958
M & T Trust Co., Buffalo.....	\$ 25,703.17	\$ 19,687.37
Savings Accounts.....	75,999.51	108,363.39
Securities.....	100,974.12	169,620.23
	<hr/>	<hr/>
	\$202,676.80	\$297,670.99
FUNDS OF THE ASSOCIATION		
Current Fund.....	\$ 325.80	\$ 1,027.14
Carus Fund.....	20,235.25	26,706.76
Chace Fund.....	8,808.28	8,760.58
Houck Fund.....	11,309.92	13,832.45
Chauvenet Fund.....	1,328.43	1,620.95
Dunkel Fund.....	15,889.55	19,451.65
General Fund.....	38,414.63	51,428.83
	<hr/>	<hr/>
	\$ 96,311.86	\$122,918.26
Visiting Lecturers Fund.....	\$ 48,424.53	\$ 38,285.38
Fund for Committee on Undergraduate Program.....	55,669.95	88,691.79
Fund for Committee on Films.....	85.66	—
Fund for Committee on High School Contests.....	2,184.80	427.34
Washington Conference Fund.....	—	2,337.42
Survey of Non-Teaching Mathematical Employment.....	—	1,218.43
Secondary School Lecturers Fund.....	—	16,054.92
Fund for Committee on Production of Films.....	—	27,827.45
	<hr/>	<hr/>
	\$202,676.80	\$297,670.99

THE NOVEMBER MEETING OF THE INDIANA SECTION

The Fall meeting of the Indiana Section of the Mathematical Association of America was held at Marian College, Indianapolis, on November 6, 1958. The program was as follows:

Professor Judah Rosenblatt of Purdue University gave a one hour lecture on *Statistics and Aircraft Warning Systems*.

Professor Charles Brumfiel of Ball State Teachers College reported on the 13th annual national T.E.P.S. conference at Bowling Green State University.

Professor J. C. Polley, Wabash College, described the activities of the Indiana School and College Committee on Mathematics.

A panel composed of Professors Charles Brumfiel, Melvin Henriksen of Purdue University, Donald Lewis of the University of Notre Dame, and George Whaples of Indiana University, and moderated by Professor Merrill Shanks of Purdue University, discussed proposals of the M.A. A. Committee on the Undergraduate Program.

CHARLES BRUMFIEL, *Secretary*

THE JANUARY MEETING OF THE NORTHERN CALIFORNIA SECTION

The twenty-first annual meeting of the Northern California Section of the Mathematical Association of America was held at Stanford University, January 17, 1959. Professor B. J. Lockhart, Chairman of the Section, presided at the morning session and Professor G. C. Preston, Vice-Chairman of the Section, presided at the afternoon session. There were 134 persons in attendance, including 96 members of the Association.

At the business meeting the following officers were elected for the coming year: Chairman, Professor G. C. Preston, San Jose State College; Vice-Chairman, Professor S. P. Hughart, Sacramento State College; Secretary-Treasurer, Professor Roy Dubisch, Fresno State College.

By invitation of the section, Professor J. L. Snell, Dartmouth College and Stanford University, delivered an address at the morning session entitled *Markov Chains and Their Applications*. An abstract of this address follows:

Recent applications of mathematics to the social sciences have given a renewed interest to the study of finite Markov chains. A procedure developed with J. G. Kemeny for systematically computing many of the basic descriptive quantities for a Markov chain was described. A discussion of some of the new applications of Markov chains was given.

At the end of the afternoon session a panel discussion was held by the newly-appointed Committee to Study the Activities of the Section consisting of Professor David Blakeslee, Chairman, Professors Henry Alder, Roy Dubisch, Harley Flanders, J. G. Herriot, Marjorie Hoffman, Brooks Lockhart, G. C. Preston, and Messrs. Kenneth Skeen and E. H. Swift. Some of the topics discussed were: The type of program most desirable for the regular meetings; what can we do to cooperate more fully with other organizations; the possibility of joint meetings with the California Mathematics Council; what would constitute the most workable executive committee; should we continue the lectureship program; should dues be collected and activities increased; should we issue a bulletin; how can we best extend our activities to include Hawaii; how can we cooperate with the Academy of Science in planning mathematics projects; and how can we work for the improvement of instruction in high schools.

Also, at this time, reports were given on the high school contest and lectureship program.

The following papers were presented:

1. *Acceptability in mathematics*, by Professor C. C. Torrance, U. S. Naval Postgraduate School, Monterey.

Is it *necessary* that a method be "logical" for it to be acceptable? Is it *sufficient* that a method produce "the right answer" for it to be acceptable? It is claimed here that the answer to both questions is *no*; consequent difficulties are discussed, and a method of resolution is indicated.

2. *Medial quasigroups*, by Professor D. A. Norton, University of California, Davis.

A short review of the concept of mediality, its significance and elementary properties.

3. *Roots and canonical forms of compound matrices*, by Dr. C. M. Ablow and Dr. J. L. Brenner, Stanford Research Institute.

Let A be a matrix in which the i th row R_i is obtained by applying the $(i-1)$ th power of a permutation P to the sequence of elements $\{a_j\}_1^n$ of the first row. If P is the circular permutation of

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THE MATHEMATICAL ASSOCIATION OF AMERICA, INC.
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The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The May Meeting of the Indiana Section

Charles Brumfiel (Secretary)

To cite this article: Charles Brumfiel (Secretary) (1959) The May Meeting of the Indiana Section, *The American Mathematical Monthly*, 66:10, 946-947, DOI: [10.1080/00029890.1959.11989436](https://doi.org/10.1080/00029890.1959.11989436)

To link to this article: <https://doi.org/10.1080/00029890.1959.11989436>



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THE MATHEMATICAL ASSOCIATION OF AMERICA

Official Reports and Communications

CONFERENCES FOR LECTURERS AT NSF 1959 SUMMER INSTITUTES IN MATHEMATICS

In March 1959, the National Science Foundation granted \$58,000 to the MAA for the support of Conferences for Lecturers at 1959 Summer Institutes in Mathematics. President Allendoerfer had appointed a committee of the Association to organize these conferences, consisting of Professors E. G. Begle and G. B. Thomas, Chairman. Five regional conferences were held at the following places and times: Boston, April 11 and 12; Washington, D. C., April 18; Chicago, May 2 and 3; St. Louis, May 2; Palo Alto, May 2. A total of approximately 300 people attended these conferences.

The conferences were intended to improve the instruction in summer institutes through mutual discussions among instructors both experienced and inexperienced in institute operations, and to provide opportunity for exchange of information concerning the course content improvement activities of the Commission on Mathematics, the School Mathematics Study Group, the University of Illinois Mathematics Project, and the Association's Committee on the Undergraduate Program in Mathematics. At each of the five conferences were speakers representing each of these groups, a speaker with experience as an institute lecturer and a former participant in a summer institute.

It had been hoped that all lecturers at 1959 summer institutes in mathematics could be invited to one of the conferences. Because of the difficulty in securing this information in a brief time, invitations to the conferences were sent directly to the directors of summer institutes to transmit to the lecturers. This formula was used: in the case of an institute devoted solely to mathematics and intended for 50 or fewer participants, the director and one lecturer were invited. In the case of an institute directed solely to mathematics and involving more than 50 participants, the director and two lecturers were invited. For an institute involving mathematics in addition to other scientific subjects, one lecturer, in the field of mathematics, was invited. Since many of the directors had had experience in previous institutes, they were able to contribute much to the general discussion that took place at each conference.

Each of the organizations represented at the Conferences supplied printed or mimeographed material which could be used at a forthcoming summer institute. Each participant was given a summary of "Comments on NSF Summer Institutes," compiled by Professor Begle, which presented the reactions, experiences, and recommendations of lecturers at previous summer institutes.

A substantial number of the participants expressed appreciation to the Association and the National Science Foundation for arranging the conferences and commented that the conferences had been useful to them.

THE MAY MEETING OF THE INDIANA SECTION

The thirty-sixth annual spring meeting of the Indiana Section of the Mathematical Association of America was held Saturday, May 2, at Valparaiso University, Valparaiso, Indiana. Approximately 60 members attended. President G. N. Wollan of Purdue University, Chairman of the Section, presided at both the morning and afternoon sessions.

The following officers were elected: Chairman, Professor K. H. Carlson of Valparaiso University; Vice-Chairman, Professor M. E. Shanks of Purdue University; Secretary-Treasurer, Professor C. F. Brumfiel of Ball State Teachers College.

Professor Wollan reported upon the activity of the State School and College Committee. This committee is comprised of representatives of the Indiana Section of the Association and of the Indiana Council of Teachers of Mathematics. It represents a

cooperative endeavor on the part of high school and college teachers to study curriculum problems in mathematics in the elementary school, high school and college.

Professor Edwards, Chairman of the Committee on Awards, reported that one Association Medal had been awarded this year to a high school senior who exhibited high mathematical achievement in the Indiana Science Talent Search program.

The Annual High School Mathematics Contest, sponsored by the M.A.A. and the Society of Actuaries was discussed and it was agreed that the Indiana Section would continue to sponsor this test.

Professor Daniel Zelinsky of Northwestern University gave the invited hour address on "Tensor Products."

The following short papers were presented:

1. *Inverse functions vs. "converse" functions*, by Professor Joong Fang, Valparaiso University.

In general the mathematical inverse implies the identical in this sense, that if a function has an inverse, the latter is always able to undo whatever the former does. If " f " is considered an operator, " f^{-1} " is an inverse operator and $ff^{-1}(x) = f^{-1}f(x) = x$. The common practice in virtually all texts (e.g., *Universal Mathematics I*, pp. 243-4) to produce the inverse function f^{-1} of a function f merely by interchanging the variables of f is thus entirely unwarranted. A new term "converse function" is recommended for such a case.

2. *A comment on the algebra of sets*, by Professor Joong Fang, Valparaiso University.

The identity set (in the proper sense) whose conspicuous absence has been either ignored or unsuspected, reveals its absurdity through the equivocality in inverse set-operations.

3. *Matrices over rings in which finitely generated ideals are principal—a survey*, by Professor Melvin Henriksen, Purdue University.

4. *Some remarks concerning the teaching of the Hilbert system*, by Professor Philip Dwyer, Purdue University.

The program of a course on "classical geometries" is outlined. After a critical discussion of the Euclidean system a rigorous treatment of the Hilbert system is given. The axiom of Pasch is presented in a stronger form. Instead of the axioms of congruence, the axioms of geometric displacements (Euclidean transformations) are introduced. Several models of non-Euclidean geometries are discussed. Particular attention is paid to hyperbolic geometry.

5. *Comments on a Notre Dame undergraduate mathematics program*, by Professor N. B. Haaser, University of Notre Dame, introduced by the Secretary.

The purpose of the program is to present elementary analysis both as mathematics and as an instrument of science and to do this in the spirit and the light of contemporary mathematics.

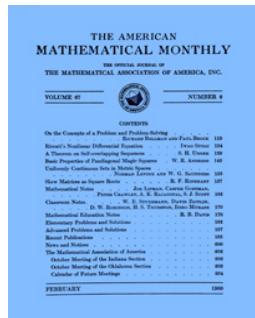
6. *Minimal fundamental sequences of functions*, by Professor Casper Goffman, Purdue University, introduced by the Secretary.

In a separable, metric, topological vector space, a sequence $\{f_n\}$ is fundamental if its finite linear combinations are dense in the space. It is minimal, if no proper subsequence is fundamental. Talalyan has shown that, for the space F of all measurable functions on $[0, 1]$, every fundamental sequence $\{f_n\}$ remains fundamental after any finite number of terms are deleted. This implies $\{f_n\}$ is universal in the sense that there are constants $\{a_n\}$ such that if $S_n = \sum_{k=1}^n a_k f_k$, then for every $f \in F$, a subsequence of $\{S_n\}$ converges a.e. to f . These results are shown here to be almost immediate consequences of the fact that the dual of F is trivial.

CHARLES BRUMFIELD, *Secretary*

THE MAY MEETING OF THE UPPER NEW YORK STATE SECTION

The fifteenth annual meeting of the Upper New York State Section of the Mathematical Association of America was held at Hartwick College, Oneonta, New York, on May 9, 1959. The Chairman of the Section, Professor Caroline A. Lester of the New



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The October Meeting of the Indiana Section

C. F. Brumfiel (Secretary)

To cite this article: C. F. Brumfiel (Secretary) (1960) The October Meeting of the Indiana Section, *The American Mathematical Monthly*, 67:2, 202-203, DOI: [10.1080/00029890.1960.11989474](https://doi.org/10.1080/00029890.1960.11989474)

To link to this article: <https://doi.org/10.1080/00029890.1960.11989474>



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Mr. A. J. Kainen, Georgia Institute of Technology, has been appointed Assistant Professor at the University of Tampa.

Dr. Ferdinand Kertes has retired as Head of the Department of Mathematics at Perth Amboy High School, New Jersey.

Dr. R. K. Meany has been appointed Assistant Professor at Texas Christian University.

Mr. L. F. Nichols, Picatinny Arsenal, Dover, New Jersey, has been appointed Instructor at Stevens Institute of Technology.

Dr. Gordon Raisbeck has taken a one year leave of absence from the Bell Telephone Laboratories to accept a temporary appointment to the staff of the Advanced Research Projects Division of the Institute of Defense Analyses, Washington, D. C.

Mr. K. A. Retzer, Saunemin High School, Saunemin, Illinois, has been appointed Assistant Professor at Illinois State Normal University.

Mr. Winston Riley, III, International Business Machines Corporation, Cleveland, Ohio, has joined the Operations Research Branch of the Corporation for Economic and Industrial Research, Arlington, Virginia.

Mr. J. F. H. Schluep, Cato Meridian Central School, Cato, New York, has been appointed Associate Professor at the State University of New York, College of Education at Oswego.

Mr. M. C. Schwartz, Philco Corporation, has been appointed Lecturer at Harpur College of the State University of New York.

Mr. E. R. Willard, University of Rochester, has been appointed Instructor at Hamilton College.

Professor Emeritus Joseph Bowden, Adelphi College, died in June, 1959. He was a charter member of the Association.

Professor Emeritus Arthur Rosenthal, Purdue University, died September 8, 1959. He was a member of the Association for eighteen years.

THE MATHEMATICAL ASSOCIATION OF AMERICA

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THE OCTOBER MEETING OF THE INDIANA SECTION

The annual fall meeting of the Indiana Section of the Mathematical Association of America was held on October 30, 1959, at Butler University, Indianapolis, Indiana, in conjunction with the meeting of the Indiana Academy of Science. Professor G. N. Wollan, Chairman of the Mathematics Section of the Academy presided at the morning session and Professor K. H. Carlson, Chairman of the Indiana Section of the Association presided at the afternoon session.

Professor Carlson was elected Chairman of the Mathematics Section of the Academy for 1960.

The following program was presented:

Morning Session—10 A.M. to 1 P.M.

1. *Computers and the collegiate mathematics program*, a symposium, by Professor P. T. Mielke, Wabash College, Professor Seymour Parter, Indiana University, Dr. K. L. Nielsen, Allison Division of General Motors, and Dr. John Lawrence, Chicago Office of I.B.M.

2. *Some advantages of Riemann-Stieltjes integration*, by Professor G. L. Krabbe, Purdue University.

3. *Uncertainty and entropy*, by Professor J. H. Abbott, Purdue University.

Afternoon session—3:30 P.M. to 5:30 P.M.

4. *Generalized functions—a survey*, by Professor Michael Golomb, Purdue University.

5. *A new introduction to the ideas and methods of trigonometry*, by Professor R. J. Thomas, DePauw University.

6. *A new look at least squares*, by Professor Richard Dowds, Butler University.

7. *A definition of polynomials on topological groups, and some examples*, by Professor F. W. Carroll, Purdue University.

C. F. BRUMFIELD, *Secretary*

THE OCTOBER MEETING OF THE OKLAHOMA SECTION

The fall meeting of the Oklahoma Section of the Mathematical Association of America was held at Oklahoma City University, Oklahoma, on October 23, 1959. Professor E. P. Richardson, Chairman of the Section presided. There were 114 persons in attendance, including 64 members of the Association.

The following officers were elected for a one-year term: Chairman, Professor Katherine Mires, Northwestern State College; Vice-Chairman, Professor R. G. Laatsch, University of Tulsa; Secretary-Treasurer, Professor R. V. Andree, University of Oklahoma.

The fall meeting of the Oklahoma Section is held in conjunction with the Oklahoma Education Association and is devoted to expository papers of particular interest to high school teachers. Research papers are presented in the spring meeting. The following papers were presented:

1. *Mann's theorem on the Landau-Schnirrmann alpha plus beta hypothesis*, by Professor Charles Nicol, University of Oklahoma.

2. *Probability and inductive inference*, by Dr. F. A. Graybill, Oklahoma State University of Agriculture and Applied Science.

3. *Recent developments in geometry*, by Professor T. K. Pan, University of Oklahoma.

4. *Metric postulates for plane geometry*, by Professor Gene Levy, University of Oklahoma.

5. *The relation between abstract algebra and the high school mathematics curriculum*, by Professor J. E. Hoffman, Oklahoma State University of Agriculture and Applied Science.

6. *Vectors in high school geometry*, by Professor Arthur Bernhart, University of Oklahoma.

7. *Experience with the UICSM project*, by Professor Eunice Lewis, University of Oklahoma.

8. The luncheon speaker was Professor Jack Forbes of Ball State Teachers' College, Muncie, Indiana. Professor Forbes spoke to the combined membership of the Oklahoma Section of the Mathematical Association of America and the Oklahoma Council of Teachers of Mathematics.

9. Another combined session of these two groups was a *panel discussion* led by three of the teachers who participated as members of the writing group for secondary school text materials which met at Boulder, Colorado, during the summer of 1959.

Committee reports included the report of the high-school lecture committee, which is serving as a clearing house for invitations from high school mathematics groups desiring college speakers. Finances will not permit sponsoring a regular traveling lecturer, but the



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The May Meeting of the Indiana Section

Charles Brumfiel (Secretary)

To cite this article: Charles Brumfiel (Secretary) (1960) The May Meeting of the Indiana Section, The American Mathematical Monthly, 67:8, 827-828, DOI: [10.1080/00029890.1960.11989608](https://doi.org/10.1080/00029890.1960.11989608)

To link to this article: <https://doi.org/10.1080/00029890.1960.11989608>



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The following papers were presented:

1. *On the applications of B_θ -spaces to summability theory*, by Mr. H. R. Coomes, University of Kentucky.

A discussion of the work of Zeller together with some new criteria in order that $B(AX) = BA(X)$ for matrices A and B and sequences X .

2. *A note on the convergence of $1 + \sum_{n=0}^{\infty} \binom{m}{n} x^n$ for $x = \pm 1$* , by Professor Aughtum Howard, Eastern Kentucky State College.

The author gives an elementary proof of the convergence of the binomial series $1 + \sum_{n=0}^{\infty} (-1)^n \binom{m}{n}$, $0 < m < 1$, and of $1 + \sum_{n=0}^{\infty} \binom{m}{n}$, $-1 < m < 0$.

3. *On the fundamental theorem of linear equivalences in kinematic relativity*, by Professor W. S. Krogdahl, University of Kentucky.

4. *On half-groups*, by Professor Frank Levin, University of Kentucky.

5. *Concerning the Euler differential equation*, by Miss Helen S. Weihe, University of Kentucky.

This talk was concerned with solving the Euler equation by means of the substitution $y = (ax+b)^m$.

6. *On the Visiting Lecturer Program*, by Professor T. J. Pignani, University of Kentucky.

7. *Revisions in the mathematics curriculum at Western Kentucky State College*, by Professor A. G. Anderson, Western Kentucky State College.

Changes in the mathematics offerings at Western Kentucky State College, to become effective next fall, were outlined. Emphasis is on providing separate programs at the first year level for students majoring and minoring in mathematics and/or science and the group categorized under the general heading "non-science" students. At the junior-senior level, a similar separation is made to provide distinct programs meeting the needs of the group preparing for positions in secondary education and those having as objectives positions in business or industry or further training in mathematics at the graduate level.

8. *Generalization of an ordered group*, by Mr. W. K. Cope, University of Kentucky.

V. F. COWLING, *Secretary*

THE MAY MEETING OF THE INDIANA SECTION

The thirty-seventh annual spring meeting of the Indiana Section of the Mathematical Association of America was held Saturday, May 7, 1960 at Earlham College, Richmond, Indiana. Approximately 50 members of the Association attended. Professor Kermit Carlson of Valparaiso University, Chairman of the Section, presided at both the morning and afternoon sessions.

The following officers were elected: Chairman, Professor M. E. Shanks, Purdue University; Vice-Chairman, Professor J. E. Yarnelle, Hanover College; Secretary-Treasurer, Professor P. T. Mielke, Wabash College.

Professor J. C. Polley reported on the activities of the State School and College Committee for Mathematics. This is a joint Committee of the Indiana Section of the Association, the Indiana Academy of Science, and the Indiana Council of Teachers of Mathematics. The purpose of the committee is to foster cooperation between school and college mathematics teachers and the State Department of Public Instruction. It was announced that a grant had been received from the National Science Foundation to support committee activities for the coming year.

A report on the National Test sponsored by the Association and the Actuarial Society, prepared by Professor Jack Forbes, was presented. It was decided that next year the Indiana School and College Committee would sponsor this test within the state.

Professor R. H. Bing of the University of Wisconsin presented the guest lecture on *Recent Developments in Euclidean Topology*.

The following short papers were presented:

1. *The Earlham statistics program*, by Professors Roland Smith and Howard Alexander, Earlham College.
2. *Trends in teacher education*, by Professor Charles Brumfiel, Ball State Teacher's College.
3. *The additive group of real numbers*, by Professor Johannes DeGroot, Purdue University.
4. *Approximate solutions of the Dirichlet problem*, by Professor Donald Greenspan, Purdue University.
5. *On repeated integrals*, by Professor J. H. B. Kemperman, Purdue University.
6. *The recursive relation in Pascal's triangle*, by Professor Dale Mesner, Purdue University.

CHARLES BRUMFIEL, *Secretary*

THE MAY MEETING OF THE MINNESOTA SECTION

The annual spring meeting of the Minnesota Section of the Mathematical Association of America was held on May 7, 1960 at St. Olaf College in Northfield, Minnesota. Professor C. S. Carlson of St. Olaf College presided at the morning session. The Section Chairman, Professor Jerry Heuer of Concordia College, presided at the afternoon session. There were 68 registered for the meeting, of whom 55 were members of the Association.

At the business meeting Professor Seymour Schuster of Carleton College reported on the 1960 Minnesota High School Mathematics Contest which was sponsored, in part, by the Minnesota Section. 261 high schools and 9,655 students participated in the contest this year. The thanks of the section were expressed to Professor Schuster and his committee for doing an excellent job in handling the contest.

It was suggested that it would be helpful to the colleges and high schools in Minnesota if the Association discovered and published the natures of the available mathematics programs at the colleges and universities in the state. It was moved and passed that a committee be appointed to study this matter.

The motion was made and passed to accept with thanks a donation made to the section for the purpose of purchasing name tags to be used at section meetings. The donation was made by Dr. E. J. Parker of Remington-Rand Univac.

The following officers were elected to serve during the school year of 1960-61: Chairman, Professor Fulton Koehler of the University of Minnesota; Secretary-Treasurer, Professor Murray Braden of Macalaster College; Members of the Executive Committee, Professor O. E. Stanaitis of St. Olaf College and Professor Warren Thomsen of Mankato State College.

The following papers were presented:

1. *Density theorems for sets of integers, and a generalization*, by Professor William Moser, University of Manitoba. (by invitation of the Executive Committee).

Let $f(x)$ be defined, integrable and $0 \leq f(x) \leq 1$ on $[0, 1]$; $g(x) = 1 - f(x)$ on $[0, 1]$; $f(x) = g(x) = 0$ outside $[0, 1]$. Furthermore let $\int_0^1 f(x) dx \geq \alpha t$, $0 \leq t \leq 1$, α a fixed real positive number, $0 < \alpha < 1$. Let $D(t) = \int_0^1 f(x)g(x+t)dx$ and $D = \inf_{t \in [0,1]} \sup_{x \in [0,1]} D(t)$. Bounds for D are found. The methods used and the results obtained are generalizations of similar results regarding the density of the sum of two sequences of integers (See Kasch, Math. 3 vol. 62, 1955 pp. 368-387). Related problems are discussed and a brief outline of the history of these problems is given.

2. *An obvious—but untrue—algebraic result related to geometry*, by Professor Seymour Schuster, Miss Alison Krotter, and Mr. Don Olivier, Carleton College.



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The October Meeting of the Indiana Section

P. T. Mielke (Secretary)

To cite this article: P. T. Mielke (Secretary) (1961) The October Meeting of the Indiana Section, *The American Mathematical Monthly*, 68:2, 202-202, DOI: [10.1080/00029890.1961.11989643](https://doi.org/10.1080/00029890.1961.11989643)

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THE OCTOBER MEETING OF THE INDIANA SECTION

The annual joint meeting of the Indiana Section of the Mathematical Association of America with the Indiana Academy of Science was held on Friday, October 7, 1960, at Manchester College, North Manchester, Indiana. Professor Kermit Carlson of Valparaiso University presided at the morning session and Professor M. E. Shanks of Purdue University at the afternoon session. The meeting was attended by 43 persons, of whom 26 were members of the Association.

Professor J. C. Polley of Wabash College, Chairman of the Indiana School and College Committee on Mathematics, announced a meeting to be held at Purdue University on October 22 under the aegis of the committee. This meeting, the first of five to be sponsored by the committee during the year, had for its theme the preparation of secondary school teachers. Professor E. E. Moise of Harvard University was to be the principal speaker.

Professor R. C. Buck of the University of Wisconsin, Chairman of the Committee for the Undergraduate Program in Mathematics, delivered the invited hour address entitled, "Crises, Past and Present," a commentary on the changes being wrought in the teaching of mathematics and their causes. The following short papers were presented:

1. *Mathematics and the younger generation*, by Professor H. J. Zassenhaus, University of Notre Dame.

2. *The mathematics program at Rose Polytechnic Institute*, by Professor T. P. Palmer, Rose Polytechnic Institute.

3. *The state of mathematics in the State of California*, by Professor Harley Flanders, Purdue University.

4. *Comments on the liaison between high school and college mathematicians*, by Professor A. E. Hallerberg, Valparaiso University.

5. *Interdepartmental seminar: a new course at DePauw University*, by Professor R. J. Thomas, DePauw University.

P. T. MIELKE, *Secretary*

THE OCTOBER MEETING OF THE IOWA SECTION

A combined meeting of the Iowa Section of the Mathematical Association of America and the National Council of Teachers of Mathematics was held October 10 and 11, 1960, at the State University of Iowa, Iowa City, Iowa. The meeting was a Regional Orientation Conference in Mathematics, sponsored by the National Council of Teachers of Mathematics under the Regional Director, Dr. H. V. Price, State University of Iowa. Some twenty members of the Iowa Section attended the conference.

The following program was presented:

1. *Progress in mathematics and its implications for the secondary school*, by Dr. G. B. Price, Executive Secretary, Conference Board of the Mathematical Sciences.

Changes in presenting mathematical materials today were described as being so great as to be called revolutionary. Three causes of this revolution were: (1) advances made in mathematics as a result of mathematical research; (2) automation revolution-introduction of machines that control machines; (3) introduction of large scale automatic computing machines. Implications for schools were: (1) small high schools cannot normally provide the program and teachers needed; (2) many high school teachers need more training; (3) higher standards should be required of teach-



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The May Meeting of the Indiana Section

P. T. Mielke (Secretary)

To cite this article: P. T. Mielke (Secretary) (1961) The May Meeting of the Indiana Section, *The American Mathematical Monthly*, 68:8, 837-838, DOI: [10.1080/00029890.1961.11989775](https://doi.org/10.1080/00029890.1961.11989775)

To link to this article: <https://doi.org/10.1080/00029890.1961.11989775>



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the ray $\theta = \exp(2\pi i/n)$, thence along this ray to the origin. The integral along this ray equals $-\exp[(m+1)2\pi i/n] \int_0^R x^m dx / (x^n + a)$. Thus we get $\int_0^\infty x^m dx / (x^n + a) = \pi / \{na^{(n-m-1)/n} \sin[(m+1)\pi/n]\}$.

6. On iterations with errors, by Professor Peter Frank, Syracuse University.

The iterates of a contraction mapping T converge to the fixed point of the mapping. While computing T an error can be made. The two cases where the errors are uniformly bounded and "random" were discussed.

7. Maximality and reflexive-symmetric relations, by Professor A. R. Bednarek, University of Buffalo.

If R is a reflexive and symmetric relation over the space X , a set $S \subset X$ is called R -scattered if and only if $X \neq Ry$ for every pair of distinct elements $x, y \in S$. E. J. Mickle and T. Radó (*On covering theorems*, Fund. Math., vol. 45, 1957, pp. 325–331) proved that given R as above there exists an R -scattered subset S of X such that $X = R(s)$; where $R(S) = \bigcup_{x \in S} R(x)$ and $R(x) = \{y | y \in X \text{ and } yRx\}$. In the present paper it is shown that this result is equivalent to the assertion of the existence of a maximal R -scattered set $S \subset X$ and to the proposition that every R -scattered subset of X is contained in a maximal R -scattered subset of X . By a particularization of R , some of the set-theoretic maximality principles were shown to be immediate consequents of the above.

8. A generalization of the contracting mapping theorem and its numerical application, by Professor W. C. Rheinboldt, Syracuse University.

The contraction mapping theorem is well known and various generalizations have been proposed. For numerical applications it is very advantageous to consider iterations of the form $x_{n+1} = F_n(x_n)$, where F_n is a convergent sequence of operators in a suitable metric space. A convergence-proof for such a type of iteration has been given by H. Ehrmann. Under rather general conditions another simple proof can be obtained by using the original contraction mapping theorem. Several examples of practical applications underline the usefulness of the method.

9. The M.A.A. films *Mathematical Induction*, with Professor L. A. Henkin, were shown.

N. G. GUNDERSON, *Secretary*

THE MAY MEETING OF THE INDIANA SECTION

The spring meeting of the Indiana Section of the Mathematical Association of America was held on Saturday, May 6, 1961, at Rose Polytechnic Institute, Terre Haute, Indiana. Professor T. P. Palmer of Rose Institute presided at the morning session and Professor John Yarnelle of Hanover College at the afternoon session. The meeting was attended by 62 persons, of whom 42 were members of the Association.

Officers for the year 1961–62, elected at the afternoon session, are Professor John Yarnelle, Hanover College, Chairman; Professor Ernst Snapper, Indiana University, Vice Chairman; and Professor P. T. Mielke, Wabash College, Secretary-Treasurer.

Professor Ernst Snapper delivered the invited hour address entitled "The Foundations of Mathematics" in which he sketched the history of the Russell Paradox and its effect upon the foundations of mathematics. The following short papers were presented:

1. *A preliminary report on the use of teaching machines in teaching mathematics to engineering and science students*, by Professor A. R. Schmidt, Rose Polytechnic Institute.

2. *Dexsinal gauges*, by Mr. Aaron Miller, Indianapolis, Indiana.

3. *A student's eye view of the Rose curriculum*, by Mr. S. D. Burton, Rose Polytechnic Institute.

4. *A comparison of five recent texts in unified calculus*, by Professor P. T. Mielke, Wabash College.

The texts reviewed were those of Johnson and Kiokemeister; Haaser, LaSalle and Sullivan; G. B. Thomas's 3rd Edition; Federer and Jonsson; and J. F. Randolph. The first three have been used at Wabash.

5. *A preliminary report on the Lynn Reeder Astronomical Laboratory*, by Professor I. P. Hooper, Rose Polytechnic Institute.

In addition to the short papers, Professor C. E. Maudlin, Rose Polytechnic Institute, conducted a tour of the Waters Computing Laboratory and supervised a demonstration of the Institute's Bendix G15d computer.

P. T. MIELKE, *Secretary*

PROFESSIONAL OPPORTUNITIES IN MATHEMATICS

A fifth edition of this popular booklet was published by the Association in September 1961. The new edition is a completely revised version of an article which appeared originally in the January 1951 number of this MONTHLY. It was prepared by a committee consisting of A. H. Bowker, C. R. Phelps, Mina S. Rees, S. A. Robertson, C. E. Sealand, and J. S. Frame, Chairman.

Although the new edition has been increased in size from 24 to 32 pages, the price remains at 25 cents for single copies and 20 cents each for five or more copies. Orders with payment should be sent to the Buffalo office of the Association.

CALENDAR OF FUTURE MEETINGS

Forty-fifth Annual Meeting, Sheraton-Gibson Hotel, Cincinnati, Ohio, January 24-26, 1962.

Forty-third Summer Meeting, University of British Columbia, Vancouver, August 27-29, 1962.

The following is a list of the Sections of the Association with dates of future meetings so far as they have been reported to the Associate Secretary.

ALLEGHENY MOUNTAIN, Chatham College, Pittsburgh, Pennsylvania, Spring, 1962.	NEW JERSEY, St. Peter's College, Jersey City, November 4, 1961.
ILLINOIS, North Central College, Naperville, May 11-12, 1962.	NORTHEASTERN, November 24, 1962
INDIANA, Butler University, Indianapolis, May 5, 1962.	NORTHERN CALIFORNIA, University of California, Davis, January 13, 1962.
IOWA, Wartburg College, Waverly, April 13-14, 1962.	OHIO
KANSAS, Bethel College, North Newton, April 28, 1962.	OKLAHOMA, Oklahoma City University, October 27, 1961.
KENTUCKY, University of Kentucky, Lexington, Spring, 1962.	PACIFIC NORTHWEST, Western Washington College, Bellingham, June 14, 1963.
LOUISIANA-MISSISSIPPI, Tulane University, New Orleans, Louisiana, February 16-17, 1962.	PHILADELPHIA, Ursinus College, Collegeville, Pennsylvania, November 25, 1961.
MARYLAND-DISTRICT OF COLUMBIA-VIRGINIA, Catholic University, Washington, D. C., December 2, 1961.	ROCKY MOUNTAIN, South Dakota School of Mines, Rapid City, Spring, 1962.
METROPOLITAN NEW YORK	SOUTHEASTERN, Woman's College, University of North Carolina, Greensboro, March 30-31, 1962.
MICHIGAN, University of Michigan, Ann Arbor, March 24, 1962.	SOUTHERN CALIFORNIA, Long Beach State College, March 9, 1962.
MINNESOTA, Moorhead State College, November 4, 1961.	SOUTHWESTERN
MISSOURI, Missouri School of Mines, Rolla, Spring, 1962.	TEXAS, Rice University, Houston, April, 1962.
NEBRASKA, University of Nebraska, Lincoln, April 13-14, 1962.	UPPER NEW YORK STATE, Clarkson College of Technology, Potsdam, Spring, 1962.
	WISCONSIN, Marquette University, Milwaukee, May 12, 1962.



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

The May Meeting of the Indiana Section

P. T. Mielke (Secretary)

To cite this article: P. T. Mielke (Secretary) (1962) The May Meeting of the Indiana Section, *The American Mathematical Monthly*, 69:7, 709-709, DOI: [10.1080/00029890.1962.11989961](https://doi.org/10.1080/00029890.1962.11989961)

To link to this article: <https://doi.org/10.1080/00029890.1962.11989961>



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7. *A proof of the extremal value theorem*, by Professor Gerald Jungck, Bradley University, introduced by the secretary.

It is shown that if $f(x)$ is continuous on $[a, b]$ and if $f(a)$ is not maximum, then the l.u.b. of the set $S = \{c \in (a, b) | \exists a \text{ point } d \in [c, b] \ni f(d) > f(x) \text{ for } x \in [a, c]\}$ yields the maximum value of $f(x)$ on $[a, b]$.

8. *Note on the existence of the definite integral*, by Professor C. E. Langenhop, Southern Illinois University and Professor John M. H. Olmsted, Southern Illinois University, presented by Professor Olmsted.

Techniques for establishing existence of mathematical entities based on limit processes are relatively advanced when their values are unknown. For example, the integrability of products involves much greater sophistication than does that of sums. For beginning classes in calculus there is no elementary proof of integrability for continuous functions. However, the two additional assumptions of a bounded derivative and existence of a primitive on the closed interval of integration (both clearly true for the most frequently encountered functions) make a proof of integrability, with a simultaneous proof of the fundamental theorem of integral calculus, practical for consideration in a beginning course.

A. W. McGAUGHEY, *Secretary*

THE MAY MEETING OF THE INDIANA SECTION

The spring meeting of the Indiana Section of the Mathematical Association of America was held at Butler University, Indianapolis, on Saturday, May 5, 1962, under the aegis of the Indiana School and College Committee on Mathematics. One hundred forty persons attended the meeting, including fifty-one members of the Association.

Professor John Yarnelle of Hanover College, Chairman of the Section, presided at the meeting. New officers of the Section, elected at a brief business meeting, are Professor Ernst Snapper, Indiana University, Chairman; Professor Kaj Nielsen, Butler University, Vice-Chairman; and Professor Paul Mielke, Wabash College, Secretary-Treasurer.

The program for the meeting centered on the study of geometry and consisted of three one-hour lectures, each followed by forty-five minutes of discussion, as follows:

1. *The high school curriculum in geometry or Is Euclid on the skids?*, by Professor R. A. Rosenbaum, Wesleyan University.
2. *The college curriculum in geometry*, by Professor R. H. Bruck, University of Wisconsin.
3. *Lines in projective space*, by Professor H. S. M. Coxeter, University of Toronto.

P. T. MIELKE, *Secretary*

THE MAY MEETING OF THE KENTUCKY SECTION

The annual meeting of the Kentucky Section of the Mathematical Association of America was held at the University of Kentucky, Lexington, Kentucky, on May 5, 1962. Professor A. W. Goodman, Chairman of the Section, presided at both the morning and afternoon sessions. Fifty-seven persons attended the meeting including forty-nine members of the Association.

At the business meeting, the following officers were elected for the coming year: Chairman, Professor W. H. Spragens, University of Louisville; Secretary-Treasurer, Professor W. C. Royster, University of Kentucky.

By invitation Professor B. J. Pettis delivered an hour address at the afternoon session. The title of his address was "Some Comments on the Structure of Mathematics."

The following papers were presented:

1. *The 1961 Curriculum Study in Mathematics*, by Professor A. S. Howard, Eastern Kentucky State College.

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October Meeting of the Indiana Section

P. T. Mielke (Secretary)

To cite this article: P. T. Mielke (Secretary) (1963) October Meeting of the Indiana Section, *The American Mathematical Monthly*, 70:2, 238-238, DOI: [10.1080/00029890.1963.11990071](https://doi.org/10.1080/00029890.1963.11990071)

To link to this article: <https://doi.org/10.1080/00029890.1963.11990071>



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OCTOBER MEETING OF THE INDIANA SECTION

The fall meeting of the Indiana Section of the Mathematical Association of American was held at Evansville College, Evansville, on Friday, October 19, 1962, in conjunction with the annual meeting of the Indiana Academy of Science. Forty seven persons attended, including 18 members of the Association. Professor John Yarnelle of Hanover College presided at the morning session, which included one short paper and a panel discussion on the question, *Should a course in calculus be a regular part of the high school curriculum?* Panelists were Edna E. Vinson, Mathematics Coordinator for the city schools of Evansville and Head of the mathematics department of Harrison High School; Professor G. N. Wollan of Purdue University; and Professor P. T. Mielke of Wabash College.

Professor Ernst Snapper of Indiana University presided at the afternoon session, which included a business meeting and an invited hour address by Professor J. C. Lillo of Purdue University. Professor Lillo's subject was, *An Introduction to the Stability Theory of Differential Equations.*

Professor J. C. Polley of Wabash College reported during the business meeting that he had been asked by Professor C. O. Oakley to coordinate the Association's Secondary School Lecturers Program for the schools of Indiana and Ohio during the next two years.

The following short paper was presented at the morning session:

1. *Bi-angular coordinates: the N-sectrix*, by Mr. Myron Effing, Evansville College.

Pairs of numbers are shown to locate points in a plane by use of a coordinate system in which the variables are angles. The locus of the equation of the first degree (of the "N-sectrix") divides any angle into any desired number of parts. Graphing is easily accomplished by means of a general relation which yields the number and location of asymptotes. A conversion to rectangular coordinates proves the derivation of the circle, hyperbola, trisectrix of Maclaurin, the trisectrix, Freeth's nephroid, Freeth's super-trisectrix, and others, as members of the N-sectrix family.

P. T. MIELKE, *Secretary*

NOVEMBER MEETING OF THE MINNESOTA SECTION

The annual fall meeting of the Minnesota Section of the Mathematical Association of America was held on November 3, 1962, at Bemidji State College of Bemidji, Minnesota. Professor P. M. Grabarkewitz, Bemidji State College, presided at the morning session, and the Section Chairman, Professor W. J. Thomsen, Mankato State College, presided at the afternoon session. There were 81 persons registered for the meeting, of whom 53 were members of the Association.

During the business meeting, the following resolution was passed: Whereas the Advisory Committee of the State Board of Education is now preparing new guidelines for teacher education in mathematics, and whereas the Committee on the Undergraduate Program in Mathematics of the Mathematical Association of America has prepared recommendations for the training of mathematics teachers at the elementary, junior high, and high school level which are both realistic and in accord with the contemporary knowledge, therefore, be it resolved that the Minnesota Section of the Mathematical Association of America, meeting at Bemidji State College, urges that the C.U.P.M. recommendations be incorporated in the guidelines for teacher training in Minnesota; and be it further resolved that we urge that similar action be taken in other states.

Also passed during the business meeting was a motion empowering the Section Chairman to appoint a Committee which will be concerned with the implementation of the recommendations of C.U.P.M. for the training of elementary school teachers.

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ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

October Meeting of the Indiana Section

P. T. Mielke (Secretary)

To cite this article: P. T. Mielke (Secretary) (1964) October Meeting of the Indiana Section, *The American Mathematical Monthly*, 71:2, 237-237, DOI: [10.1080/00029890.1964.11992224](https://doi.org/10.1080/00029890.1964.11992224)

To link to this article: <https://doi.org/10.1080/00029890.1964.11992224>



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SUMMER 1964 RESEARCH PARTICIPATION

College teachers of mathematics who wish to spend the summer (10 weeks) of 1964 doing research in mathematics or in computer science are encouraged to apply for NSF Research Participation Awards at the University of Oklahoma. Stipends vary from \$750 to \$1600, plus travel.

Participants will devote full time to research of their own choice using the excellent facilities at the University of Oklahoma. Each participant will enroll in at least one advanced course or seminar in mathematics or computer science (June 8-August 2) and will also be expected to contribute two lectures to a research seminar. Special informal seminars can be arranged for small groups with common interests. Preference will be given to applicants who have a project sufficiently well in mind to outline it in their application.

Academic Year Extensions of \$2000 each will also be made available by NSF to support the work of several participants at their home institution during the following year—\$1500 will be for direct support of the participant's research and \$500 for strengthening the mathematical program of the participant's home institution by improving the library in his field of research, or other mathematical activity. These extensions can be made to holders of either the predoctoral or postdoctoral awards.

If you are interested, write to Professor Richard V. Andree, Mathematics Service Committee, University of Oklahoma, Norman, Oklahoma.

THE MATHEMATICAL ASSOCIATION OF AMERICA*Official Reports and Communications***OCTOBER MEETING OF THE INDIANA SECTION**

The fall meeting of the Indiana Section of the Mathematical Association of America was held on Saturday, October 12, 1963, at North Central High School, Indianapolis. One hundred and eleven persons attended, of whom 49 were members of the Association. Chairman Harley Flanders of Purdue University presided at both morning and afternoon sessions. The meeting consisted of a symposium on the subject *Mathematics Education Abroad* and an invited hour address. Symposium discussion centered around three lectures as follows:

1. *On some aspects of Soviet mathematics education*, by Professor Izaak Wirsup, University of Chicago.
2. *The mathematical tripos and mathematical education in Great Britain*, by Professor Daniel Pedoe, Purdue University.
3. *Mathematical training in Indian universities*, by Professor Pesi R. Masani, Indiana University.

The invited hour address by Professor Timothy O'Meara of the University of Notre Dame was entitled *The Celebrated Theorem of Hasse-Minkowski in Number Theory*.

The meeting opened with a short welcoming address by Mr. Milo Eiche, Principal of North Central High School, whose mathematics staff, under the chairmanship of Mr. Allan Weinheimer, was responsible for local arrangements for the meeting.

At a short business meeting the Section voted to continue the practice of holding two meetings a year but to discontinue holding its fall meeting in conjunction with the Indiana Academy of Science.

P. T. Mielke, *Secretary*



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

May Meeting of the Indiana Section

P. T. Mielke (Secretary)

To cite this article: P. T. Mielke (Secretary) (1964) May Meeting of the Indiana Section, *The American Mathematical Monthly*, 71:8, 952-953, DOI: [10.1080/00029890.1964.11992360](https://doi.org/10.1080/00029890.1964.11992360)

To link to this article: <https://doi.org/10.1080/00029890.1964.11992360>



Published online: 11 Apr 2018.



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6. *Repeated quadrature methods for the numerical solution of differential equations*, by L. D. Gates, Jr., Southern Illinois University.

A one-step method for numerical solution of differential equations uses a first order difference equation in place of a first order differential equation, the best known being the Runge-Kutta methods. A new family, the methods of repeated quadratures, is described. A method having order of accuracy n is obtained by using a quadrature formula of n th order accuracy with one-step methods whose accuracy is at least of order $n-1$. The methods of repeated quadrature are much easier to derive than the Runge-Kutta methods, and are somewhat better with respect to error propagation at the cost of being less efficient in computing time.

7. *Groups with nilpotent commutator subgroup*, by E. E. Shult, Southern Illinois University.

The following results are presented:

(a) Let V be a group of order pq acting as a fixed-point-free group of automorphisms on a solvable group G . If pq does not divide $o(G)$, the order of G , and if neither p nor q are Fermat primes when $o(G)$ is even, then G has nilpotent length at most 2.

(b) If, in (a), V is the symmetric group S_3 , then G has nilpotent commutator subgroup.

(c) Let V be a solvable group with the property that whenever V is a fixed-point-free group of operators on a solvable group, G , for which $(o(G), o(V))=1$, G' is nilpotent. Then V is either cyclic of prime order, has order 4, or is S_3 .

ARNOLD WENDT, *Secretary*

MAY MEETING OF THE INDIANA SECTION

The spring meeting of the Indiana Section of the MAA was held on Saturday, May 2, 1964, at Butler University, Indianapolis. Ninety-eight persons attended of whom 60 were members of the Association. Chairman Harley Flanders of Purdue University presided. The meeting consisted of a symposium on *Probability and Statistics*. Discussions centered around the following hour lectures:

1. *The Zero-One laws of probability theory*, by D. L. Burkholder, University of Illinois.
2. *The statistical basis of decision under uncertainty*, by Leo Katz, Michigan State University.
3. *Industrial applications of quality control statistics*, by Irving W. Burr, Purdue University.
4. *Statistical inference in a problem of disputed authorship*, by D. L. Wallace, University of Chicago.

The authorship referred to is that of the *Federalist Papers*. This lecture has been published under the title "Inference in an Authorship Problem" in the Journal of the American Statistical Association, 58 (1963) 275-309.

The meeting also included a period for discussion of the role of the Section in high school contests. In the past, two types of contest have been held in the state, that of the Mathematical Association of America and a special contest sponsored by Indiana University. A crisis has been created by the recent decision of Indiana University to discontinue its contest, which had enjoyed considerable popularity, especially for use at the more elementary levels. Several school teachers expressed the opinion that the MAA contest cannot fill the void thus created and that a new contest is needed to replace the Indiana University contest. The question considered was whether the Section should assume the responsibility for this new contest. There was general agreement that it should not, since by so doing it would be putting itself in competition with its national parent organization. It was the consensus rather that the Section should actively encourage state schools to use the MAA contest and also to seek means within the MAA for giving the contest wider appeal.

At the business meeting there was a discussion of the Visiting Lecturer Program of

the Indiana Academy of Science by Prof. W. G. Kessel of Indiana State College, director of the program.

Officers elected for the coming year are: R. E. Dowds, Butler University, Chairman; Robert Troyer, Indiana University, Vice-Chairman; and Paul Mielke, Wabash College, Secretary-Treasurer.

P. T. MIELKE, *Secretary*

MAY MEETING OF THE KENTUCKY SECTION

The Kentucky Section of the MAA met May 1-2, 1964 at the University of Kentucky, Lexington, Kentucky. Professor J. C. Eaves, Chairman of the Section, presided. The first session dealt with mathematical education. Participants in this program were Professor J. C. Eaves, University of Kentucky, Chairman of the Kentucky Section; Dr. Sidney Simandle, Kentucky State Department of Education; Dr. Allan Anderson, Western Kentucky State College; Professor Alvin McGlasson, Eastern Kentucky State College; Brother Edward Daniel, St. Xavier High School; Dr. T. J. Pignani, University of Kentucky and Dr. Leland Scott, University of Louisville.

The following officers were elected for the coming year: Chairman R. S. Park, Eastern Kentucky State College; Secretary-Treasurer, W. C. Royster, University of Kentucky.

Papers presented at the second session were:

1. *Finite difference formulae for the Laplacian operator*, by W. S. Krogdahl, University of Kentucky.

For the purposes of numerical computation, the Laplacian operator is customarily given by some suitable finite difference operator. Such operators are generally represented by symmetric stencils which represent the array of coefficients of the values of the function at the points of a square grid. These stencils are not unique. It was shown how suitable stencils might be generated and a method was suggested for eliminating the ambiguity in a systematic way.

2. *Restricted convergence of multiple series*, by Henry Spragens, University of Louisville.

A discussion of various schemes for summing multiple series was given along with several examples.

3. *Quasi-conformal mappings by the Grotzsch definition*, by Harold Robertson, University of Kentucky.

An expository talk on the Grotzsch definition and quasi-conformal mappings was given. A generalization of the Schwarz lemma was obtained for K -quasi-conformal mappings.

4. *Simple applications of functional analysis*, by Casper Goffman, Purdue University (by invitation).

Two examples, one concerning summability and one concerning universal series, were used to indicate how functional analysis can be applied to give simple and precise results in analysis.

5. *Remarks on product integrals*, by Raymond Cox, University of Kentucky.

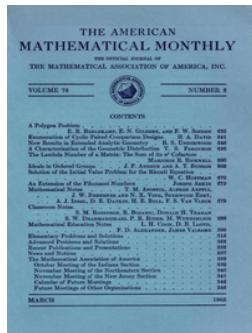
The notion of a *product integral* for a function A , from the real line to a set of $n \times n$ matrices, was discussed.

In particular, necessary and sufficient conditions on A were given to insure the existence of the product integral; and several properties of the integral, such as its plane series expansion, were given.

6. *On matrix representation of cubic forms*, by J. C. Eaves, University of Kentucky.

The multiplication of matrices is extended to include three dimensional matrices in such a way that the expression for the general cubic in n variables is given as a product of matrices, one of which is of dimension $n \times n \times n$.

W. C. ROYSTER, *Secretary*



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

October Meeting of the Indiana Section

P. T. Mielke (Secretary)

To cite this article: P. T. Mielke (Secretary) (1965) October Meeting of the Indiana Section, *The American Mathematical Monthly*, 72:3, 339-340, DOI: [10.1080/00029890.1965.11970527](https://doi.org/10.1080/00029890.1965.11970527)

To link to this article: <https://doi.org/10.1080/00029890.1965.11970527>



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Dean J. B. Davis, Amarillo College, has been appointed Dean Emeritus and Professor of Mathematics.

Dr. P. O. Frederickson, University of Nebraska, has been appointed Assistant Professor at Case Institute of Technology.

Mr. C. R. McAllister, Booz, Allen Applied Research, Inc., Los Angeles, California, has been promoted to Research Director in the Western Operations Office.

Assistant Professor J. R. McCarthy, College of the Holy Cross, is on leave during 1964-65 for special studies in statistics at the Catholic University of America.

Professor C. E. Miller, University of Saskatchewan, has been appointed Head of the Department of Mathematics.

Professor J. M. Perry, Clarkson College of Technology, is on leave during 1964-65 as a Visiting Member of the Institute for Fluid Dynamics and Applied Mathematics at the University of Maryland.

Associate Professor F. B. Taylor, Manhattan College, has been appointed Head of the Department of Mathematics.

Professor Emeritus B. A. Bernstein, University of California at Berkeley, died on September 25, 1964. He was a charter member of the Association.

Dr. D. F. Gunder, Loveland, Colorado, died on October 21, 1964. He was a member of the Association for 30 years.

Professor Emeritus R. G. Putnam, New York University, died on July 14, 1964. He was a member of the Association for 40 years.

MATHEMATICAL ASSOCIATION OF AMERICA

Official Reports and Communications

OCTOBER MEETING OF THE INDIANA SECTION

The Indiana Section met on Saturday, October 31, 1964, at Ball State Teachers College, Muncie. 125 persons attended of whom 60 were members of the Association. Chairman R. E. Dowds of Butler University presided. The morning was devoted to short papers and the afternoon to a business meeting and an invited hour address entitled "Experimental Methods in Number Theory" by Professor Hans Zassenhaus of the Ohio State University.

Papers presented at the morning session were:

1. *Two applications of stochastic processes to actuarial science*, by John A. Beekman, Ball State Teachers College.

Collective risk theory is discussed in terms of stochastic processes. The double Laplace transforms for the two major distribution functions are expressed as iterated integrals involving the characteristic function of the claim distribution. In non-insurance terms, the distribution functions are for the maximum of sums of random numbers of independent, identically distributed random variables, and for the probability that the random sums stay below a line. In insurance terms, the first distribution is for total claims, and the second is for the probability of ruin, for specified claim distribution, initial reserve, premiums and security loadings.

2. *Free topological groups*, by Robert L. Cooley, Wabash College.

The free topological groups $FM(X)$ and $FG(X)$ of Markov and Graev, respectively, are defined and shown to be different for a given completely regular space X . Results include the follow-

ing: If X is compact, then both $FM(X)$ and $FG(X)$ are normal and complete. X is discrete iff $FM(X)$ and $FG(X)$ are discrete. $FG(X)$ is connected iff X is connected, while $FM(X)$ is never connected. For a given space X , however, the abelian groups $AM(X)$ and $AG(X)$ are locally isomorphic.

$AM(X)$ and $FG(X)$ are factor groups of $FM(X)$; $AG(X)$ is a factor group of $FG(X)$ and of $AM(X)$. $S(Y)$, the subgroup generated in $FM(X)$ by Y , is equal to $FM(Y)$ iff Y is closed in X .

3. A generalization of Buffon's needle problem, by Rodney T. Hood, Franklin College.

A checkerboard of red and black squares, each of side S , is given. A needle of length S is dropped at random on the board. One endpoint of the needle is painted red, the other black. Then the probability that the colors at the endpoints will match their background is $1/\pi$. This variant of the Buffon needle problem is considered for its pedagogical value, along with related problems, and it is solved by a method which involves a wide variety of concepts and procedures from probability, geometry and calculus.

4. A topological approach to geometry, by Michael C. Gemignani, University of Notre Dame.

A structure G called a geometry is defined on a set X using distinguished subsets of X called k -flats. If X also has a topology T , and if G and T are properly related, then G can be used to characterize X as a space up to homeomorphism, that is, G can be used to express a complete set of purely topological invariants for X . This is done for R^n . The structure G can also be studied in its own right as an abstraction of almost anything mathematics has ever called a geometry.

5. The summability of Fourier Series by Karamata methods, by Vladeta Vuckovic, University of Notre Dame.

A sequence $\{s_n\}$ is K^λ -summable to s if $\Gamma(\lambda) \sum_{n=0}^{\infty} [n]! s_n / \Gamma(\lambda + n) \rightarrow s$ as $n \rightarrow \infty$. The numbers $[n]!$ are defined by $x(x+1) \cdots (x+n-1) = \sum_{n=0}^{\infty} [n]! x^n$. For measurable and bounded periodic function f with period 2π define $w(t) = f(x+t) + f(x-t) - 2f(x)$. The author proves the theorem: If $w(t) = o(1/\log(1/t))$ as $t \rightarrow +0$, then the Fourier Series of f is K^λ -summable at the point x to $f(x)$ for every $\lambda > 0$.

6. Some aspects of the convergence of series, by G. R. MacLane, Purdue University.

One of the more difficult points in a course in elementary analysis is to induce an adequate understanding of convergence and divergence of infinite series. We are all familiar with the student who insists that any series whose terms tend to zero converges; also the one who is ensnared by the beauty of the ratio test and insists on applying it to every series under the sun. The writer has found that some students are helped to a better understanding of the complexities of the situation by a discussion of some "useless" theorems, such as: Riemann's theorem on the rearrangement of conditionally convergent series; or the fact that given any convergent series (or a countable collection of such series), there exists a convergent series which converges more slowly than the given series (than each of the given series).

P. T. MIELKE, *Secretary*

NOVEMBER MEETING OF THE NORTHEASTERN SECTION

The tenth annual meeting of the Northeastern section of the MAA was held on November 28, 1964, at the Worcester Polytechnic Institute in Worcester, Mass. There were 132 people registered for the meeting including 109 members of the Association. Professor Harold Dorwart, Chairman of the Section, presided at the morning meeting and Professor Grace Bates, Vice-Chairman of the Section, presided at the afternoon meeting. At the business meeting the following were elected as officers of the Section for the year 1964-65: Chairman, Professor Grace Bates of Mt. Holyoke College; Vice-Chairman, Professor Hartley Rogers of Massachusetts Institute of Technology; Secretary and Treasurer, Mr. Richard S. Pieters, Phillips Academy.

The following program was presented:

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The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

May Meeting of the Indiana Section

P. T. Mielke (Secretary)

To cite this article: P. T. Mielke (Secretary) (1965) May Meeting of the Indiana Section, *The American Mathematical Monthly*, 72:7, 820-820, DOI: [10.1080/00029890.1965.11970614](https://doi.org/10.1080/00029890.1965.11970614)

To link to this article: <https://doi.org/10.1080/00029890.1965.11970614>



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26. *On symmetric neighborhood systems in strongly paracompact, completely paracompact, and strongly metrizable spaces*, by Margaret R. Wiscamb, Texas Christian University.

A collection of sets $\{U(p) | p \in R\}$ is said to be symmetric if $q \in U(p)$ implies $p \in U(q)$. Using this concept, we can replace star finiteness with much weaker conditions, such as point finiteness or point countability in the definitions of strongly paracompact, completely paracompact and strongly metrizable spaces. Moreover, using this property we can relax the requirement that the refinement (resp. basis) be open in these spaces.

27. *The process for manual extraction of N-th roots of real numbers*, by John Reynolds, Texas Christian University.

A process for manual extraction of principal N th roots of real numbers has been found. The root will be a real number and therefore can be expressed as a polynomial-like function of its base. The radicand is a polynomial expansion of the root and therefore can be operated on by a division-like process to obtain the root.

28. *Cylindrical surfaces*, by R. S. Underwood, Texas Technological College.

An equation $f=0$ in n variables has a degenerate locus on a plane, facilitating its solution simultaneously with a second equation, if functions X and Y exist such that $f=f(X, Y)$. The existence or not of these functions can be determined when nonparallel tangent hyperplanes $F=0$ and $G=0$ are obtainable by the method used in 3-space. Then the plotting rule $X=F, Y=G$ in effect "stands on end" the "cylindrical surface," if such it is, and yields incidental solutions of Diophantine equations. Analysis shows the validity of this intuitive approach.

B. T. GOLDBECK, *Secretary*

MAY MEETING OF THE INDIANA SECTION

The Indiana Section of the MAA met on Saturday, May 1, 1965, at Indiana University, Bloomington, in joint session with the Indiana Council of Teachers of Mathematics. Approximately 250 persons attended, of whom 100 were members of the Association. Chairman R. E. Dowds of Butler University presided. The structure of the meeting was that of a symposium on Algebra and Linear Algebra. Discussion was centered around the following three hour lectures:

1. *From Descartes to Hilbert*, by Donald Ostberg, Indiana University.
2. *Linear Algebra and its Applications to Geometry*, by Ernst Snapper, Dartmouth College.
3. *Commutativity Theorems*, by I. N. Herstein, University of Chicago.

Officers for next year, elected at the afternoon business meeting, are George Springer, Indiana University, Chairman; Norman B. Haaser, University of Notre Dame, Vice-Chairman; and Paul Mielke, Wabash College, Secretary-Treasurer.

Local arrangements for the meeting were in charge of R. J. Troyer, Indiana University. The Indiana Council of Teachers of Mathematics and the University of Indiana shared in its financing.

P. T. MIELKE, *Secretary*

MAY MEETING OF THE METROPOLITAN NEW YORK SECTION

The twenty-fourth annual meeting of the Metropolitan New York Section of the MAA was held on May 1, 1965 at Manhattan College. There were 125 persons present of whom 82 were members of the Association. The following officers were elected: Chairman, Walter Cassidy, St. John's University; Vice-Chairman for Colleges, Meyer Jordan, Brooklyn College; Vice-Chairman for High Schools, Benjamin Bold, Stuyvesant High School; Secretary, Mary Hagen, Pace College; Treasurer, Aaron Shapiro, Midwood



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

November Meeting of the Indiana Section

P. T. Mielke (Secretary)

To cite this article: P. T. Mielke (Secretary) (1966) November Meeting of the Indiana Section, *The American Mathematical Monthly*, 73:2, 227-229, DOI: [10.1080/00029890.1966.11970744](https://doi.org/10.1080/00029890.1966.11970744)

To link to this article: <https://doi.org/10.1080/00029890.1966.11970744>



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of (circa) 1700 B.C. concerning principles of Euclidean geometry formerly attributed solely to the Greeks of a later era. Two of the latest mathematical tablets unearthed contain unique and unusual solutions of triangle areas and their relationships.

9. *A variant of the two-dimensional Riemann integral*, by A. J. Goldman, National Bureau of Standards, Washington, D. C.

S. Marcus (this MONTHLY, 71 (1964) 544-545) proposed a variant of the two-dimensional Riemann integral and observed that $f(x, y) = x$ failed to be integrable. Here a necessary and sufficient condition is given for integrability, the gist of which is that the function must be very nearly constant. In particular, the constants are the only continuous integrable functions.

10. *Commutative semi-groups and pseudo-inverses*, by Kenneth D. Taylor, Army Map Service, Washington, D. C.

If c is such that $acb = ab$ for all a, b in the semi-group, then c is called a pseudo-inverse. The theorems and corollaries center about the principal theorem: If G is a semi-group with an element d in G such that for all a, b in G $adb = ba$, then the semi-group is commutative. The maximal sub-semi-group of G which is a group, is found. Finally, the question of whether an extension will produce a pseudo-inverse is discussed.

S. S. SASLAW, *Secretary*

MAY MEETING OF THE MARYLAND-DISTRICT OF COLUMBIA-VIRGINIA SECTION

The annual Spring meeting of the Maryland-District of Columbia-Virginia Section of the MAA was held at the University of Maryland, College Park, Maryland, on May 1, 1965. Dr. Daniel Shanks, Chairman of the section presided. There were 110 persons in attendance, including 96 members of the Association. Very lively discussions followed both the morning and afternoon sessions.

At the business meeting the following officers were elected:

Chairman, Professor Samuel S. Saslaw, United States Naval Academy, Annapolis, Maryland; Vice Chairmen, Professor Hyman Kamel, Howard University, Washington, D. C.; and Professor Thomas L. Reynolds, College of William and Mary, Williamsburg, Virginia; Secretary, Professor George N. Trytten, University of Maryland, College Park, Maryland; Treasurer, Professor Stanley B. Jackson, University of Maryland, College Park, Maryland.

The following program was presented:

1. *The aims and purposes of the Committee on the Undergraduate Program in Mathematics of the Mathematical Association of America*, by Samuel Eilenberg, Columbia University (invited address).

2. *Question and discussion period.*

3. *What Graduate Schools in the Area Expect of New Students*, Panel discussion. Participants: Gustav B. Hensel, Catholic University of America; John D. Miller, University of Virginia; Bruce Reinhart, University of Maryland.

4. *Question and Discussion period.*

S. S. SASLAW, *Secretary*

NOVEMBER MEETING OF THE INDIANA SECTION

The Indiana Section of the MAA met on Saturday, November 6, 1965, at Franklin College, Franklin. Approximately 100 persons attended, of whom 67 were members of the Association. Chairman George Springer of Indiana University presided. The morning was devoted to short papers and the afternoon to a business meeting and an invited hour address entitled "Categories" by Professor Samuel Eilenberg of Columbia University.

Papers presented at the morning session were:

1. *Fiducial theory and invariant estimation*, by R. B. Hora, Indianapolis Branch, Purdue University, and R. J. Buehler, University of Minnesota. (Report by R. B. Hora.)

Let P^ω be a family of distributions which satisfy assumptions that are essentially equivalent to those of Fraser (*Biometrika*, 48 (1962) 261) but are closer to those of Stone (*Ann. Math. Stat.*, 36 (1965) 440). Let E_f denote fiducial expectation and E_R the conditional expectation given the ancillary. It is shown that for invariant functions $H(x, \omega)$, the identity $E_f H = E_R H$ holds. The identity has been applied to obtain best invariant estimators for "invariantly estimable functions." Finally, the relations between estimation of "invariantly estimable functions" and coset estimation and fiducial and confidence limits have been considered.

2. *Programmed instruction in college level mathematics*, by Thomas A. Davis, DePauw University.

This was a discussion of the use of programmed instruction in pre-calculus mathematics at DePauw University during 1964-65. The program included such topics as inequalities, absolute values, symmetry, asymptotes, and equations of straight lines. The performance of students who used the programmed material was slightly better than that of students who learned the same material by the traditional classroom lecture and discussion method. The time spent on the program was about one-half the time spent by the students who learned the material in the classroom.

3. *Binary relations as the basis for a fact retrieval system*, by Roger Elliott, Indiana State University.

A model for a computer fact retrieval system is developed. The model accepts facts and queries couched in a relational language, and it constructs data structures which are efficient for storing the input data and which permit efficient inference-making. Data are presented verifying an hypothesized independence of retrieval time of the size of the data base.

4. *Extremal properties of spline interpolants*, by Michael Golomb, Purdue University.

An extremal property possessed by interpolating spline functions was derived which includes all the minimizing properties of these approximants found previously (Schoenberg, Sard, Golomb-Weinberger, Holladay, et al.).

5. *On regular rings*, by Jiang Luh, Indiana State University. Following O. Steinfeld, a subring Q of a ring A is said to be a quasi-ideal of A if $AQ \cap QA \subseteq Q$. In this paper characterizations for regular rings and for strongly regular rings are given in terms of quasi-ideals.

6. *Behavior of derivatives*, by A. Bruckner, University of California at Santa Barbara, visiting Professor at Purdue University.

The speaker gave an exposition of classical examples of functions possessing various properties with respect to differentiability.

7. *On the Hodgkin-Huxley partial differential equation*, by H. Melvin Lieberstein, Indiana University.

The equations for propagation of impulses on an unmyelinated squid axon are modified to include effects of core capacitance and inductance without introducing any new parameters. One equation is the one dimensional wave operator acting on a function whose values represent voltage across a surrounding membrane, set equal to a non-linear function of membrane voltage and its first time derivative. This is taken together with the first order differential equations for the Hodgkin-Huxley empirical parameters n , m and h . Voltage is specified as a $-15mv$ sawtooth or square impulse at a cut end and is required to be initially zero together with its first time derivative along the axon. This generates numerically a -100 or a $-103mv$ action potential. Initial waves of $-10mv$ die out. A wave which propagates with velocity and form constant to five digits develops as x and t increase; it satisfies a first order ordinary differential equation which replaces the former second order equation. Agreement with former calculations is excellent and the extreme sensitivity

to propagation rate is removed. The boundary value problem can be regarded as a model for transient development and propagation on a human muscle fiber. (The above work has been supported by NIH grant HE 10034).

Local arrangements for the meeting were in charge of Rodney Hood of Franklin College. President Wesley N. Haines of Franklin College welcomed participants on behalf of the college.

Six charter members of the Association now residing in Indiana were accorded special recognition at the meeting. These men are Will E. Edington, Gordon H. Graves, Paul R. Rider, Charles K. Robbins, Clarence P. Souseley and Harold E. Wolfe. Of these only Messrs. Graves and Rider were able to attend the meeting.

P. T. MIELKE, *Secretary*

NOVEMBER MEETING OF THE NEW JERSEY SECTION

The tenth annual meeting of the New Jersey Section of the MAA was held at Montclair State College, Upper Montclair, on November 6, 1965. Professor Max A. Sobel, Chairman of the Section, presided at the morning session. Professor Joshua Barlaz presided at the afternoon session. One hundred and forty-three persons attended the meeting, including one hundred and twelve members of the Association.

At the business meeting the following members were elected: Professor Joshua Barlaz of Rutgers University, Chairman of the Section (Nov. '66); Professor Bernard Greenspan of Drew University, Member-at-Large of the Executive Committee (Nov. '68); Professor Hale Trotter of Princeton University, Member-at-Large of the Executive Committee (Nov. '66); Professor John K. Reckzeh of Jersey City State College, Associate Secretary-Treasurer (Nov. '68); Professor Francis A. Varrichio of Saint Peter's College, Secretary-Treasurer. Reports were given by L. F. McAuley, Governor of the Section; J. Barlaz, Section Representative to the Summer meeting; W. A. Krzeminski, member of the High School Contest Committee; F. A. Varrichio, Secretary-Treasurer.

At the morning session the following papers were presented:

1. *Logic: Fad or Tool?* by Prof. Hassler Whitney, Institute of Advanced Study, Princeton, N. J. (By invitation.)

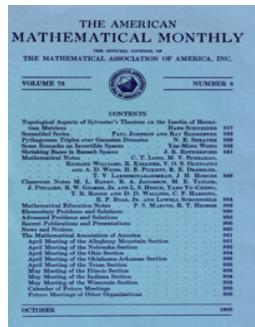
Many texts in general mathematics contain a chapter on logic; it commonly seems unconnected with actual mathematics, and is likely not to be made use of later. Yet all mathematics uses logical reasoning throughout. What is really needed is to understand the elementary principles used in actually carrying on mathematics. This involves not only propositions and quantifiers, but also an understanding of the use of symbols, the meaning of statements relative to the underlying hypotheses, etc. Various simple examples are given to illustrate these ideas.

2. *Countable Topological Spaces*, by Albert Wilansky of Lehigh University, Bethlehem, Pa. (By invitation.)

Let X be a countable T_1 space. If regular, it is normal, zero-dimensional, totally disconnected. If regular and first countable or locally compact, it is metrizable, indeed a subset of the rationals. Let $\beta = \mathbb{N} \cup \{t\}$, $t \in \mathbb{N}/N$. Then β is normal, not first countable, pseudofinite, hemicompact. Any hemicompact first countable space is locally compact. Let $X = \{t\} \cup N$ with N discrete, $t \in \mathbb{N}$; deleted neighborhoods of 0 being $\{S : \lim_{A \in X}(S) = 1\}$, A a fixed positive regular matrix. A. K. Snyder has associated topological properties of X with summability properties of A .

The afternoon session consisted of a panel discussion of *The Twelfth Year Program in High School Mathematics*. The panelists were: Mr. Martin Moskowitz of Vailsburg High School, Newark, N. J., Mr. Henry Peterson, Wayne Senior High School, Wayne, N. J., and Dr. Anthony Pettofrezzo, Montclair State College.

F. A. VARRICHO, *Secretary*



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

May Meeting of the Indiana Section

Paul Mielke (Secretary)

To cite this article: Paul Mielke (Secretary) (1966) May Meeting of the Indiana Section, *The American Mathematical Monthly*, 73:8, 934-934, DOI: [10.1080/00029890.1966.11970864](https://doi.org/10.1080/00029890.1966.11970864)

To link to this article: <https://doi.org/10.1080/00029890.1966.11970864>



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local trees as partially ordered topological spaces having certain natural restrictions. The characterizations are viewed as descriptions of the inherent order properties possessed by trees and by local trees.

5. A class of linear sequence spaces, by Sister M. Catharina Bereiter, Siena Heights College.

The linear space $L(S)$ is defined by requiring that all subsequences with index sequence in S form absolutely convergent series. If S covers the natural numbers, the supremum of these sums forms a norm in the space $B(S)$ of sequences for which it is finite, and $B(S)$ is a Banach Space. Under easily satisfied conditions $L(S)$ and $B(S)$ differ from spaces such as (l_1) and (m) . For certain S , "defined by a counting function Ω ," $B(S)$ equals $L(S)$ and is separable, but not reflexive. The dual space can be given by sequences determined directly from Ω .

6. A mnemonic simplification in linear algebra, by Zamir Bavel, Southern Illinois University.

Let U and V be finite dimensional vector spaces with D and D' ordered bases for U , R and R' ordered bases for V , $\alpha \in U$, and $T: U \rightarrow V$ a linear transformation. Denote by $[\alpha]_D$ the coordinate matrix of α relative to D ; by ${}^R[T]^D$ the matrix representing T relative to D and R ; and by $P(D \rightarrow D')$ the transition matrix from D to D' . Also regard $D \rightarrow D'$ as instructions for substitution: To perform the forward substitution $D \rightarrow D'$, replace D' by D , and to perform the backward substitution $D \rightarrow D'$, replace D by D' . In either case, the substitution "consumes" the transition matrix. RULE: (a) A transition matrix adjacent to ${}^R[T]^D$ appears on the domain (alt. range) side of ${}^R[T]^D$ when the change-of-basis occurs in the domain (alt. range) space. (b) Perform a forward substitution in what follows a transition matrix; perform a backward substitution in what is behind a transition matrix. It is now easy to remember, prove, and "invent" such theorems as

$$P(D \rightarrow C)^C[T]^A P(A \rightarrow E) P(E \rightarrow B)[\alpha]_B = {}^D[T]^B[\alpha]_B = [T(\alpha)]_D,$$

since it is impossible to misstate them.

7. A Problem in Elementary Set Theory, (Hour Address), by Philip Dwyer, University of Illinois, Chicago Circle.

ARNOLD WENDT, *Secretary-Treasurer*

MAY MEETING OF THE INDIANA SECTION

The Indiana Section of the MAA met on Saturday, May 14, 1966, at Indiana State University, Terre Haute, in joint session with the Indiana Council of Teachers of Mathematics. Approximately 200 persons attended, of whom 70 were members of the Association. Chairman George Springer of Indiana University presided, and President A. C. Rankin of Indiana State University welcomed the participants.

At its business meeting, the Section elected the following officers for the year 1966-67: Robert Zink, Purdue University, Chairman; Kenneth Sidebottom, Indiana Central College, Vice-Chairman; George Pedrick, Purdue University, Secretary-Treasurer. The Section also voted to give special recognition annually to the top Indiana team and individual in the Putnam Competition and directed its Executive Committee to determine a tangible expression of this recognition. A communication from the Mathematics Department of Indiana University was read in which it was announced that the department "each year reserves one of its regular stipends for graduate study for the participant in the Putnam Competition who ranks highest among the contestants in the State of Indiana."

The program consisted of three hour lectures as follows:

1. *Rotations, angles and trigonometry*, by R. J. Troyer, Dartmouth College.
2. *Puzzles, platonism and extraversion*, by E. E. Moise, Harvard University.
3. *Continued fractions in stability theory*, by J. S. Frame, Michigan State University.

PAUL MIELKE, *Secretary*



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

November Meeting of the Indiana Section

George Pedrick (Secretary)

To cite this article: George Pedrick (Secretary) (1967) November Meeting of the Indiana Section, *The American Mathematical Monthly*, 74:3, 350-351, DOI: [10.1080/00029890.1967.11999961](https://doi.org/10.1080/00029890.1967.11999961)

To link to this article: <https://doi.org/10.1080/00029890.1967.11999961>



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APRIL MEETING OF THE MISSOURI SECTION

The spring meeting of the Missouri Section of the MAA was held at the University of Missouri at Rolla on April 30, 1966, Professor Charles Hatfield, Chairman of the Section, presiding. Sixty-four persons were present, of whom forty-six were members.

At the business meeting, the following officers were elected for 1966-1967: Chairman, Professor Dale Woods, Northeast Missouri State Teachers College; Vice-Chairman, Professor F. W. Wilke, University of St. Louis at St. Louis; Secretary-Treasurer, Professor E. C. Pringle, Northeast Missouri State Teachers College.

Professor John Andrews reported on the high school testing program and Professor Paul Burcham on the University of Missouri (Columbia) testing program for entering freshmen.

During the morning session, Professor Guido Weiss of Washington University, St. Louis, gave the main address on "The CUPM General Curriculum in Mathematics for Colleges."

A program of new films was scheduled for the afternoon session. The following papers were presented during the morning session:

1. *A projective method for linear equations*, by R. F. Keller, University of Missouri, Columbia
2. *Solution of a difference equation by means of a contour integral*, by Gary Walls, Northeast Missouri State Teachers College.
3. *Some vector families in E^3 with integral components, integral length and useful orthogonality properties*, by J. F. Gray, Society of Mary, Kirkwood.
4. *On arbitrary large postulate sets for the propositional calculus*, by John Bridges, Southwest Missouri State College, Springfield.

C. A. JOHNSON, *Secretary-Treasurer*

NOVEMBER MEETING OF THE INDIANA SECTION

On Saturday, November 5, 1966, the Indiana Section of the MAA met at Purdue University. Approximately 150 persons attended, including 62 members of the Association who registered.

The group was welcomed by Professor F. H. Haas, Dean of the School of Science, and the sessions were presided over by Professors G. R. MacLane and R. E. Zink.

At the business meeting, it was decided unanimously that the Section would recognize the top two competitors from Indiana on the Putnam Examination by awarding them a year's membership in the Association and announcing their achievement to the membership. Professor Paul Mielke reported on a team competition held among eight small colleges in the state last year and announced plans to repeat the undertaking this year in view of its success.

The program for the meeting was as follows:

1. *Blood flow and asymptotic uniqueness of a boundary value problem*, by H. M. Lieberstein, Indiana University.
2. *A reduction of Diophantine problems*, by A. Adler, Indiana University.
3. *Mathematics and space science*, by H. Pollard, Purdue University.

4. *Convergence of Fourier series*, by C. Goffman, Purdue University.
5. *An instability result for a linear differential-difference equation with constant coefficients*, by H. Bailey, Rose Polytechnic Institute.
6. *Ordinary differential equations in Banach space and functional equations of the retarded type*, by Z. Vorel, Rose Polytechnic Institute.
7. *Pointwise periodicity and Boolean algebras*, by F. B. Wright, Tulane University (Guest Speaker).

GEORGE PEDRICK, *Secretary*

NOVEMBER MEETING OF THE NORTHEASTERN SECTION

The twelfth annual meeting of the Northeastern Section of the MAA was held at Trinity College, Hartford, Connecticut, on November 26, 1966. The registered attendance was 151, including 131 members of the Association. Chairman Hartley Rogers, of the Massachusetts Institute of Technology, presided at the morning session and Vice-Chairman Robin Robinson, of Dartmouth College, presided at the afternoon session.

At the business meeting, the following officers were elected for the coming year: Chairman, Robin Robinson, Dartmouth College; Vice-Chairman, Guilford Spencer III, Williams College; Secretary-Treasurer, George Best, Phillips Academy.

The morning program was devoted to the following talks:

1. *Equivalences of differentiable structures*, by J. R. Munkres, Massachusetts Institute of Technology.

2. *Markov chains and potential theory*, by L. J. Snell, Dartmouth College.

Following the afternoon business meeting, the program continued with a panel discussion of *The CUPM report on the general curriculum in mathematics for colleges*. The panel was moderated by A. B. Willcox, Amherst College. Panelists were: V. O. McBrien, College of the Holy Cross; E. E. Moise, Harvard University; R. A. Rosenbaum, Wesleyan University; N. J. Schoonmaker, University of Vermont.

G. W. BEST, *Secretary-Treasurer*

NOVEMBER MEETING OF THE PHILADELPHIA SECTION

The forty-first annual meeting of the Philadelphia Section of the MAA was held at Villanova University, Villanova, Pennsylvania, on November 19, 1966. The Chairman, Professor Russell Remage Jr., University of Delaware, presided at the meeting. The meeting was attended by 172 persons including 137 members of the Association.

At the business meeting the following officers were elected: Chairman: Professor Emil Amelotti, Villanova University; Member of the Executive Committee, Professor R. J. Kohlmeyer, Albright College.

The following papers were presented:

1. *Some aspects of homological algebra-background and recent developments*, by J. C. Moore, Princeton University.

2. *Components of mathematical systems*, by P. C. Hammer, The Pennsylvania State University.

3. *A brief trip through the affine plane*, by Samuel Gulden, Lehigh University.

4. *The CUPM general curriculum in mathematics for colleges*, by D. W. Western, Franklin and Marshall College; J. A. Meier, Millersville State College; David Rosen, Swarthmore College.

5. Film: *Let us teach Guessing*, with George Polya.

V. V. LATSHAW, *Secretary-Treasurer*

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November Meeting of the Indiana Section

M. J. Mansfield (Secretary-Treasurer)

To cite this article: M. J. Mansfield (Secretary-Treasurer) (1969) November Meeting of the Indiana Section, *The American Mathematical Monthly*, 76:2, 223-223, DOI: [10.1080/00029890.1969.12000179](https://doi.org/10.1080/00029890.1969.12000179)

To link to this article: <https://doi.org/10.1080/00029890.1969.12000179>



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OCTOBER MEETING OF THE MINNESOTA SECTION

The annual fall meeting of the Minnesota Section of the MAA was held at Concordia College, Moorhead on October 26, 1968. There were 107 persons registered including 81 members. At the business meeting conducted by Chairman E. J. Camp, a new set of by-laws was adopted which changes the name of the section to North Central Section.

Professor R. A. Bing, University of Wisconsin, gave the invited address, "The Elusive Fixed Point Property."

The following papers were presented:

1. *Delta curves of constant width*, by J. D. E. Konhauser, Macalester College.
2. *Numerical integration by continued fractions—An example*, by G. A. Kemper, University of North Dakota.
3. *On the construction of topological examples*, by Lynn Steen and Arthur Seebach, St. Olaf College.
4. *Some necessary and sufficient conditions for commutativity of reflections*, by W. C. Ramaley, Carleton College.
5. *On the equivalence of cancellative extensions of cancellative semi-groups by groups*, by Charles Heuer, Concordia College.
6. *A countable, connected, locally connected Hausdorff Space*, by Allan Kirch, Macalester College.
7. *The preparation of Junior College Teachers of Mathematics*. Panel discussion; moderator: Wayne Roberts, Macalester College; panelists: Charles Blackstad, Worthington State Junior College; Warren Stenberg, University of Minnesota; Richard Twaddle, Anoka-Ramsey State Junior College.

WARREN THOMSEN, *Secretary*

NOVEMBER MEETING OF THE INDIANA SECTION

The fall meeting of the Indiana Section of the MAA was held on November 2, 1968 at Butler University. There were 85 persons in attendance, including 77 members of the Association.

The group was welcomed by Dr. Alexander Jones, President of Butler University. The following program was then presented at the morning session:

1. *On Hermite-Birkhoff interpolation*, by Kendall Atkinson, Indiana University.
2. *Homomorphism topologies and abelian groups*, by B. F. Hobbs, Olivet Nazarene College.
3. *Boundary behavior for quasi-conformal mappings*, by Glenn Schober, Indiana University.
4. *Let's be honest with the undergraduate—a numerical analyst's point of view of Cramer's rule, inverses of matrices, Laplace's equation, and other formulas: some useful and others not*, by Robert Lynch, Purdue University.

Following a brief business meeting in the afternoon, Professor George Minty of Indiana University delivered an invited address on "Kirschbraun's Theorem (geometry) and its relatives, and their applications in analysis."

M. J. MANSFIELD, *Secretary-Treasurer*

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The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

October Meeting of the Minnesota Section

Warren Thomsen (Secretary)

To cite this article: Warren Thomsen (Secretary) (1969) October Meeting of the Minnesota Section, *The American Mathematical Monthly*, 76:2, 223-223, DOI: [10.1080/00029890.1969.12000178](https://doi.org/10.1080/00029890.1969.12000178)

To link to this article: <https://doi.org/10.1080/00029890.1969.12000178>



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WARREN THOMSEN, *Secretary*

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M. J. MANSFIELD, *Secretary-Treasurer*

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May Meeting of the Indiana Section

M. J. Mansfield (Secretary-Treasurer)

To cite this article: M. J. Mansfield (Secretary-Treasurer) (1969) May Meeting of the Indiana Section, *The American Mathematical Monthly*, 76:8, 985-986, DOI: [10.1080/00029890.1969.12000387](https://doi.org/10.1080/00029890.1969.12000387)

To link to this article: <https://doi.org/10.1080/00029890.1969.12000387>



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29. *Residue classes and string figures*, by A. R. Amir-Moez, Texas Technological College.
 30. *The interface between mathematics and statistics*, by P. D. Minton, Southern Methodist University.

J. C. BRADFORD, *Secretary-Treasurer*

MAY MEETING OF THE KENTUCKY SECTION

The fifty-second annual meeting of the Kentucky Section was held at Morehead State University, Morehead, Kentucky, on May 3, 1969, Chairman Billy R. Nail presiding. Seventy persons registered at the meeting, including 48 members of the Association.

At the business meeting these officers were elected: Chairman: Dr. Carl Langenhop, University of Kentucky; Secretary-Treasurer: Dr. A. S. Howard, Eastern Kentucky University; Contest Chairman: Dr. James Simpson, University of Kentucky.

Dr. Gail Young, President of the Association, gave the invited address on *Some Topological Aspects in Analysis*.

In the morning there were two parallel program sessions. One of these, presided over by Prof. L. C. Cooper of Morehead State University, concerned itself with school mathematics. It was addressed by Mr. Russell Boyd, Mathematics Consultant with the State Department of Education, Mrs. Peggy Prater, Chairman, Mathematics Department, Bath County High School, and Dr. Martha Sudduth, University of Kentucky.

At the other session the following papers were presented:

1. *A generalization of a theorem of Kirschbraun on the intersection of convex sets*, by J. H. Wells, University of Kentucky.
2. *On extending the domain of a complex-valued function satisfying a Lipschitz condition*, by T. M. Jenkins, University of Louisville.
3. *Elementary proofs of theorems on weak convergence—linear operators approach*, by Z. Govindarajulu, University of Kentucky.
4. *The intersection projection of orthogonal projections in finite dimensional spaces*, by C. E. Langenhop, University of Kentucky.
5. *The functions quasi-periodic and the nonhomogeneous linear differential equation*, by F. G. Scorsone, Eastern Kentucky University.
6. *Hamiltonian form of the geodesic equations*, by L. E. Bragg, University of Kentucky.

W. H. SPRAGENS, *Secretary-Treasurer*

MAY MEETING OF THE INDIANA SECTION

The spring meeting of the Indiana Section of the MAA was held on May 10, 1969 at the Indianapolis Campus of Purdue University. There were 70 persons in attendance, including 57 members of the Association.

The group was welcomed by Dr. R. C. Sanborn, Assistant Dean for Academic Affairs at the Indianapolis Campus. Professor B. E. Rhoades, Chairman of the Section, presided.

The following program was presented at the morning session:

1. *Bending of a cylindrical shell under a discontinuous load*, by A. K. Naghdi, Purdue University Indianapolis Campus.
2. *Some recent developments in Boolean geometry*, by H. J. Ludwig, Ball State University.
3. *On subsemigroups of groups*, by J. E. Kuczowski, Purdue University Indianapolis Campus.
4. *Qualitative properties of satellite orbits*, by P. C. Loh, Purdue University Indianapolis Campus.
5. *Primal decomposition of ideals in noncommutative rings*, by C. M. Murphy, Purdue University Calumet Campus.

At the business meeting in the afternoon, the Secretary-Treasurer reported that Mr. Stephen Helmreich of Valparaiso University and Mr. Eric Isaacson of Indiana University had each been awarded a one-year membership in the Association in recognition of their achievement in the 29th Putnam Mathematical Competition. Officers for 1969-70 were elected as follows: Chairman, Professor N. B. Haaser, University of Notre Dame; Vice-Chairman, Professor W. C. Swift, Wabash College; Secretary-Treasurer, Professor M. J. Mansfield, Purdue University at Fort Wayne.

Following the business meeting Professor G. S. Young, President of the MAA, addressed the group on "Topology and Analysis."

M. J. MANSFIELD, *Secretary-Treasurer*

MAY MEETING OF THE ROCKY MOUNTAIN SECTION

The fifty-second annual meeting of the Rocky Mountain Section of the MAA was held at the University of Colorado, Boulder, Colorado, on May 9 and 10, 1969. There were 153 persons registered for the meeting, including Professor F. M. Stein of Colorado State University, Sectional Governor, and Professor J. W. Bebernes of the University of Colorado, Section Chairman. The invited address was delivered by Professor V. L. Klee, Jr., of the University of Washington, who spoke on "Shapes of the Future—Unsolved Geometric Problems for Science and Technology." Professor W. E. Briggs, Dean of the College of Arts and Science of the University of Colorado, welcomed the Section at the banquet on Friday evening.

At the business meeting, the Report of the Nominating Committee recommending that the By-Laws of the Section be amended to provide for the election of a Second Vice-Chairman to look after the interests of the junior colleges, was approved. Professor T. D. Cavanagh, Contest Chairman of the Section, reported that 8610 students from 141 high schools participated in the 1968 MAA mathematics contest. Professor Robert McKelvey reported for the High School Lecturer Program inaugurated last year, and his recommendation that the program be continued was approved. The present committee, consisting of Professor Robert McKelvey, University of Colorado, Chairman, Professor W. R. Scott, University of Utah, and Professor Verne Varineau, University of Wyoming, was reappointed to continue the administration of this program.

The following officers were elected: Chairman, Ray Hanna, University of Wyoming, Laramie, Wyoming; First Vice-Chairman, George Stratopoulos, Weber State College, Ogden, Utah; Second Vice-Chairman, James Davis, Mesa Junior College, Grand Junction, Colorado; Secretary-Treasurer, D. J. Sterling, Colorado College, Colorado Springs.

The following papers were read at the meeting:

1. *Construction of projective ideals*, by D. W. Ballew, South Dakota School of Mines and Technology.
2. *A relationship of perfect fields to compact classes*, by A. J. Boes, Colorado School of Mines.
3. *Surfaces in three-dimensional euclidean space*, by C. E. Burgess, University of Utah.
4. *A property of perfect groups*, by Harold Finkelstein, University of Colorado.
5. *Uniform structures from abstract spaces*, by G. C. Gastle, University of Wyoming.
6. *Similarity of normal matrices in $GF(q)$* , by Mrs. Leslie Hanson and A. D. Porter, University of Wyoming.
7. *On uniform distribution of sequences in $GF(q, x)$ and $GF(q, x)$* , by J. H. Hodges, University of Colorado.
8. *Minimum and maximum topological spaces*, by R. E. Larson, University of Colorado.
9. *Perturbation of the poles of the scattering matrix*, by James LaVita, University of Denver.
10. *On computing the dimensions of spaces of automorphic functions*, by G. L. Loudner, South Dakota School of Mines and Technology.
11. *Quasi-local rings with Noetherian filtrations*, by Sylvia Chin-Pi Lu, University of Colorado (Denver Center).

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ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

November Meeting of the Indiana Section

M. J. Mansfield (Secretary-Treasurer)

To cite this article: M. J. Mansfield (Secretary-Treasurer) (1970) November Meeting of the Indiana Section, *The American Mathematical Monthly*, 77:4, 442-442, DOI: 10.1080/00029890.1970.11992513

To link to this article: <https://doi.org/10.1080/00029890.1970.11992513>



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This was a wonderful symposium, prepared by the Naval Academy and enjoyed by several hundred mathematicians.

DENNY GULICK, *Secretary*

OCTOBER MEETING OF THE OHIO SECTION

A special meeting of the Ohio Section of the MAA was held on October 25, 1969, at Denison University, Granville, Ohio. The meeting was devoted to discussion of matters related to mathematics for junior colleges. One hundred thirty-eight persons registered in attendance including ninety members of the Association. Professor James Smith, Chairman of the Section, presided at the morning session, and Professors Richard Laatsch, Raymond Rolwing and David Staley presided at the discussion groups in the afternoon. The following program was presented:

1. *Mathematics in the Two-Year College.* This was a panel discussion with J. F. Leetch as moderator, and panel members I. N. Herstein, University of Chicago, Alfred Livingston, Cuyahoga Community College, and James Mettler, Pennsylvania State University, Schuylkill.

2. *Discussion Groups:*

- A. Training and Qualifications for Two-Year College Faculty, Richard Laatsch, Miami University, Leader.
- B. The Transfer Curriculum in Mathematics, Raymond Rolwing, University of Cincinnati, Leader.
- C. Other Mathematics Offerings of the Two-Year College, David Staley, Ohio Wesleyan University, Leader.

3. *Governor's Report.* Holbrooke MacNeill, Case Western Reserve University.

FOSTER BROOKS, *Secretary*

NOVEMBER MEETING OF THE INDIANA SECTION

Ninety-one persons, fifty-six of whom were members of the Association, braved an unseasonable snowstorm to attend the fall meeting of the Indiana Section on November 15, 1969, at the University of Notre Dame.

The group was welcomed by Dr. Thomas Stewart, Assistant to the President for Planning and Analysis, University of Notre Dame. Professor Norman Haaser, Chairman of the Section, presided.

The following program of invited addresses was presented:

- 1. *Unsolved problems in intuitive geometry*, by V. L. Klee, Jr., University of Washington.
- 2. *Functional approximation*, by W. J. Cody, Jr., Argonne National Laboratory.
- 3. *Quasiconformal mappings*, by George Springer, Indiana University.

M. J. MANSFIELD, *Secretary-Treasurer*

NOVEMBER MEETING OF THE NEW JERSEY SECTION

The fourteenth annual meeting of the New Jersey Section of the MAA was held at Seton Hall University on November 1, 1969. Professor Bernard Greenspan, Chairman of the Section, presided at the morning and afternoon sessions. Sixty-five persons attended the meeting including fifty-one members of MAA.

At the business meeting, Professor Hale Trotter of Princeton University was elected Chairman, and F. W. Sinden of Bell Laboratories was elected Member at Large of the Executive Committee (1972).

During the morning session the following papers were presented:

- 1. *Sphere-packing and error-correcting codes*, by Neil Sloane, Bell Telephone Laboratories.
- 2. *Work of the CUPM Committee on Community Colleges*, by Robert Larsson, Mohawk Valley Community college.

The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

May Meeting of the Indiana Section

M. J. Mansfield (Secretary-Treasurer)

To cite this article: M. J. Mansfield (Secretary-Treasurer) (1970) May Meeting of the Indiana Section, *The American Mathematical Monthly*, 77:8, 926-926, DOI: 10.1080/00029890.1970.11992628

To link to this article: <https://doi.org/10.1080/00029890.1970.11992628>



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ham of West Virginia University, and Professor Frank Kocher of Penn State will continue as Chairman and executive member respectively for one more year. Professor Richard Moore gave an invited address entitled "Qualitative Theory of Differential Equations." Professor Harley Flanders of Purdue University was also an invited speaker. His talk was entitled "Moving Frames." A panel composed of Charles Cunkle, moderator, and, Ida Arms, Raymond Ayoub, Richard Davis, and William Hoff discussed The Program for the First Two Years in Mathematics, What and When.

MAA films were shown and there were book exhibits from publishing companies. The following papers were presented:

1. *Coordinate ring construction in the lattice of a module*, by Charles Getchell, Lycoming College.
2. *An example of an APPERT FAN SPACE*, by Steven Gendler, Clarion State College.
3. *Boundedness theorems for second order nonlinear ordinary differential equations*, by J. S. Wong, Carnegie-Mellon University.
4. *On a partition problem of H. L. Alder*, by George Andrews, Pennsylvania State University.
5. *An introduction to the theory of nonlinear stability*, by Jagdish Agrawal, California State College.
6. *Criteria for transitivity in a general projective plane*, by Mario Benedicty, University of Pittsburgh.

M. R. WOODARD, *Secretary-Treasurer*

MAY MEETING OF THE INDIANA SECTION

The spring meeting of the Indiana Section of the MAA was held on May 2, 1970 at Indiana University, Bloomington, Indiana. Approximately 60 persons attended.

Following welcoming remarks by Professor George Springer, Chairman of the Department of Mathematics at the host institution, the following program of invited addresses was presented at the morning session:

1. *Functional equations arising in stochastic processes*, by M. F. Neuts, Purdue University.
2. *Large lattices of linear manifolds*, by P. R. Halmos, Indiana University.

At the business meeting in the afternoon, the Secretary-Treasurer reported that Mr Eric Isaacson of Indiana University and Mr. George Lueker of Valparaiso University had each been awarded a one-year membership in the Association in recognition of their achievement in the 30th Putnam Mathematical Competition. Officers for 1970-71 were elected as follows: Chairman, Professor W. C. Swift, Wabash College; Vice-Chairman, Professor Casper Goffman, Purdue University; Secretary-Treasurer, Professor R. T. Hood, Franklin College.

After the business meeting, the following invited address was presented:

Mathematics in Hungary after the war, by Bela Sz-Nagy, University of Szeged, Hungary, and Indiana University.

M. J. MANSFIELD, *Secretary-Treasurer*

MAY MEETING OF THE KENTUCKY SECTION

The fifty-third annual meeting of the Kentucky Section was held at the University of Kentucky, Lexington, on Saturday, May 16, 1970, Chairman C. E. Langenhop presiding. The meeting, originally scheduled for May 9, had to be postponed one week. Seventy-three persons registered at the meeting, including 58 members of the Association.

At the business meeting, the following officers were elected: Chairman, Dr. R. C. Bueker, Western Kentucky University; Secretary-Treasurer, Dr. A. S. Howard, Eastern Kentucky University.

Dr. R. H. Cox, University of Kentucky, will serve as Contest Chairman.

The Section voted to hold the next annual meeting of the Section at Western Kentucky University, Bowling Green, Kentucky.

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ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

October Meeting of the Indiana Section

R. T. Hood (Secretary-Treasurer)

To cite this article: R. T. Hood (Secretary-Treasurer) (1971) October Meeting of the Indiana Section, *The American Mathematical Monthly*, 78:6, 700-700, DOI: [10.1080/00029890.1971.11992834](https://doi.org/10.1080/00029890.1971.11992834)

To link to this article: <https://doi.org/10.1080/00029890.1971.11992834>



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OCTOBER MEETING OF THE INDIANA SECTION

The fall meeting of the Indiana Section of the MAA was held on October 24, 1970, at Wabash College, Crawfordsville. About 70 persons attended, of whom 65 were members of the Association.

A welcome was extended by the Chairman of the Section, Professor W. C. Swift. The morning session consisted of an address by Professor R. E. Zink, Purdue University, "On the Representation of Measurable Functions by Series." This was followed by a presentation and discussion of the question of accreditation of departments of mathematics and certification of graduates, led by Professor B. E. Rhoades, Indiana University, and Professor R. G. Bartle, University of Illinois. Despite the efforts at impartiality on the part of the panel, there was no enthusiasm for the proposal among those present. One letter from an absent member supporting the proposal was read.

At the afternoon business meeting the Chairman announced his intention to appoint a committee to revise the by-laws of the Section. Following the business meeting, Professor W. P. Ziemer, Indiana University, gave an address entitled, "Some Recent Developments in the Plateau Problem."

R. T. HOOD, *Secretary-Treasurer*

NOVEMBER MEETING OF THE NORTH CENTRAL SECTION

The annual fall meeting of the North Central Section of the MAA was held at the North Dakota State University, Fargo, on November 7, 1970. Professors Robert Tidd and Charles Friese, of North Dakota State University, presided at the morning sessions and Professor Alfred Aeppli, University of Minnesota, presided at the afternoon session. One hundred thirty persons attended, including one hundred three members.

Professor I. N. Herstein, University of Chicago, gave the invited address: "Mappings Related to Homomorphisms."

Other papers presented were:

1. *Computer Supplemented Finite Algebra*, by J. F. Peters, Saint John's University, Collegeville, Minnesota.
2. *A Determinant for the Hermite Polynomial $H_n(x)$* , by F. J. Arena, North Dakota State University, Fargo, North Dakota.
3. *Distributions whose Test Functions are Sequences*, by Clayton Knoshaug, Bemidji State College, Bemidji, Minnesota.
4. *Dirichlet Series Obtained by Iteration*, by George Brauer, University of Minnesota, Minneapolis, Minnesota.
5. *Convex Functions and Differential Inequalities*, by R. M. Mathsen, North Dakota State University, Fargo, North Dakota.
6. *The Distribution of Quadratic Residues in Fields of Order p^2* , by G. E. Bergum, South Dakota State University, Brookings, South Dakota.
7. *If T is a Torsion Group, $HOM(T, G)$ is Algebraically Compact*, by Milton Legg, Moorhead State College, Moorhead, Minnesota.
8. *Algebraic Closure: a Non-Standard Approach*, by L. C. Larson, St. Olaf College, Northfield, Minnesota.
9. *Factoring Functions on Cartesian Products*, by Milton Ulmer, Macalester College, St. Paul, Minnesota.
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ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

October Meeting of the Indiana Section

R. T. Hood (Secretary-Treasurer)

To cite this article: R. T. Hood (Secretary-Treasurer) (1972) October Meeting of the Indiana Section, *The American Mathematical Monthly*, 79:7, 820-820, DOI: [10.1080/00029890.1972.11993131](https://doi.org/10.1080/00029890.1972.11993131)

To link to this article: <https://doi.org/10.1080/00029890.1972.11993131>



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(physical, behavioral, biological, medical) and the methods of applied mathematics. Additionally, the program seeks to develop the "attitude" of an applied mathematical scientist by emphasizing the totality of the discipline. The individual plan of study will be specifically programmed taking into consideration the aforementioned subjects together with the student's background, interests and goals. Students applying for admission should have an excellent background in science and mathematics.

Further information and applications may be obtained from: Chairman, Program in Applied Mathematical Science, Graduate College, University of Iowa, Iowa City, Iowa 52240.

MATHEMATICAL ASSOCIATION OF AMERICA

Official Reports and Communications

OCTOBER MEETING OF THE INDIANA SECTION

The Indiana Section of the MAA held its fall meeting on Saturday, October 30, 1971, at Earlham College, Richmond, with approximately 60 persons in attendance. The morning program consisted of three talks: a survey lecture on sequences of methods of summability of series, by Professor G. N. Wollan, Purdue University; an illustrated lecture on the life and work of Leonhard Euler, by Professor R. T. Hood, Franklin College; and a discussion of "Bi-Color Steiner-Heawood Triangulation," by Professor William Gustin, Indiana University. Following luncheon, a brief business meeting was held. Professor L. J. Cote, Purdue University, of the Editorial Committee of the Section, spoke concerning support of the Indiana School Mathematics Journal. A discussion of ways in which the Section might effectively present its views on certification requirements resulted in the appointment of a committee, consisting of Professors Mielke (Wabash), Hallerberg (Valparaiso), and McKinney (Ball State), to act as liaison between the Section and the State Department of Education with regard to changes in certification requirements. Also a committee is to be appointed to initiate revision of the by-laws for the Section.

Following the business meeting, a guest lecture on Brownian Motion was presented by Professor D. L. Burkholder, University of Illinois.

R. T. HOOD, *Secretary-Treasurer*

NOVEMBER MEETING OF THE NEW JERSEY SECTION

The sixteenth annual meeting of the New Jersey Section of the MAA was held at Stevens Institute of Technology on November 13, 1971. Eighty-one persons attended the meeting, including 70 members of MAA.

At the afternoon business meeting, Professor M. E. White of Stevens Institute of Technology was elected Secretary-Treasurer and Eileen L. Poiani of St. Peter's College was elected Associate Secretary-Treasurer; Professor F. E. Clark of Rutgers University was elected to the Executive Board, Professor Theodore Faraklas of Ocean County College became Chairman of the section.

The morning meeting was chaired by Professor Faraklas and the following papers were presented:

The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

May Meeting of the Indiana Section

R. T. Hood (Secretary-Treasurer)

To cite this article: R. T. Hood (Secretary-Treasurer) (1973) May Meeting of the Indiana Section, The American Mathematical Monthly, 80:1, 114-115, DOI: [10.1080/00029890.1973.11993241](https://doi.org/10.1080/00029890.1973.11993241)

To link to this article: <https://doi.org/10.1080/00029890.1973.11993241>



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NEWS AND NOTICES

EDITED BY RAOUL HAILPERN, SUNY at Buffalo

Readers are invited to contribute to the general interest of this department by sending news items to Mathematical Association of America, 1225 Connecticut Avenue, NW, Washington, D. C. 20036. Items must be submitted at least two months before publication can take place.

PERSONAL ITEMS

Emory University: Assistant Professor C. C. Ross, Jr., has been promoted to Associate Professor; Professor Henry Sharp, Jr., has been appointed Chairman of the Department of Mathematics.

Assistant Professor Emeric Deutsch, Polytechnic Institute of Brooklyn, has been promoted to Associate Professor.

Assistant Professor R. A. Duke, University of Washington, has been appointed Assistant Professor and Assistant Director of the School of Mathematics at Georgia Institute of Technology.

Dr. J. F. Kuzanek, mathematician and Acting Chief of the Maintenance Scheduling Systems Branch, U. S. Army Construction Engineering Research Laboratory, Champaign, Illinois, has been appointed Assistant Professor at the University of Redlands.

Associate Professor J. D. Neff, Georgia Institute of Technology, has been promoted to Professor and appointed Director of the School of Mathematics.

Assistant Professor Warren Page, New York City Community College, has been promoted to Associate Professor.

Assistant Professor D. Z. Spicer, Vassar College, has been promoted to Associate Professor.

Dr. William Stenger, Ambassador College, has been promoted to Professor.

MATHEMATICAL ASSOCIATION OF AMERICA

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MAY MEETING OF THE INDIANA SECTION

The Indiana Section of the MAA held its spring meeting Saturday, May 13, 1972, at Franklin College, Franklin, Indiana, with approximately fifty persons in attendance. During the morning session Professor Leonard Berkovitz, Purdue University, spoke on the topic, "Calculus of Variations and Optimal Control," and Professor Peter Fillmore, Indiana University, spoke on the topic, "The Shift Operator."

At the business meeting, following a luncheon, reports were heard from Professor Louis Cote for the Editorial Committee (inviting articles and subscriptions for the Indiana School Mathematics Journal which is published with the support of the Section), from Professor Paul Mielke for the Committee on Revision of Indiana Teacher Certification Rules, and from the Secretary for the By-Law Revision Committee. The proposed by-laws were adopted

with minor changes. In connection with the report of Professor Rhoades, of the Board of Governors, the Section discussed the matter of national collection of section dues. Professor Wollan submitted the recommendations for officers for the year 1972-73: Professor H. B. Hanes, Jr., Earlham, for Chairman; Professor E. F. McKinney, Ball State, for Vice-Chairman; Professor R. T. Hood, Franklin, for Secretary-Treasurer. These were elected unanimously. Concern over low attendance at meetings was passed on to a committee consisting of Professors Goffman and Golomb.

Following the business meeting, Professor Edward Fadell, University of Wisconsin, delivered a guest lecture on the topic: "The Dirac String Problem."

R. T. HOOD, *Secretary-Treasurer*

EMPLOYMENT INFORMATION FOR MATHEMATICIANS

The current employment situation for mathematicians has necessitated the establishment of a new information service on employment to replace the Employment Register. The American Mathematical Society, with the partial support of the Mathematical Association of America and the Society for Industrial and Applied Mathematics, will publish the new *Employment Information for Mathematicians* bimonthly in February, April, June, July, October, and December. The October 1972 issue appeared in November 1972.

Each issue will consist of four sections. The first section will include a list of all available positions submitted by the chairmen of departments of mathematics; the second section will list alphabetically all those institutions without available positions; the third section will consist of an alphabetical list of all institutions (universities and colleges), including the complete mailing address, that have not responded to the regularly distributed questionnaire; the fourth section will include information on government, industrial, and foreign positions as they are received in the Providence office of the AMS. The foreword of each issue will include statistical data on the job market from such sources as the *Notices*, the *Monthly*, and committees, as well as a statistical analysis of the responses for the particular issue.

Information will be collected from a bimonthly mailing to all chairmen of departments of mathematics who are on the master mailing list of the AMS. Chairmen will receive a preprinted return postcard which they will be asked to submit by a specified deadline. Chairmen may provide information on available openings, or indicate that no openings are available. One of the advantages of this system is that if a chairman states that no openings are available, he will not be obligated to answer letters from applicants, thereby relieving him of a heavy burden of correspondence. This service will provide mathematicians with a comprehensive source of information on the employment situation six times a year.

The new service will be under the supervision of the Joint Committee on Employment Opportunities which has been expanded, and now includes the following members: R. D. Anderson, R. A. Handelman, Judah Rosenblatt (chairman), and W. N. Smith; the name of one additional member of the committee has not yet been announced.

The price to individuals for six issues of the *Employment Information for Mathematicians* is \$20. Information on prices to institutions may be obtained by writing to the Mathematical Sciences Employment Register, P. O. Box 6248, Providence, Rhode Island 02904.

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Disability Income Plan Added to the MAA Group Insurance Program

To cite this article: (1973) Disability Income Plan Added to the MAA Group Insurance Program, *The American Mathematical Monthly*, 80:7, 844-844, DOI: [10.1080/00029890.1973.11993383](https://doi.org/10.1080/00029890.1973.11993383)

To link to this article: <https://doi.org/10.1080/00029890.1973.11993383>



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Literature and consultant services pertinent to the issues raised in these guidelines are available from the Mathematical Association of America. There should be evidence that the department is aware of these resources and uses them as needed.

**DISABILITY INCOME PLAN ADDED TO THE MAA GROUP
INSURANCE PROGRAM**

SIAM, MAA and AMS have cooperated once again in expanding the Group Insurance Program to include new coverage designed to provide protection during a period of disability caused by accident or illness. Enrollment in the Plan is open to all actively working members of our organizations under 60, but during the Special Charter Period, eligibility extends to age 65. Since a member's earning ability is one of his most valuable assets, this Disability Income Plan should be a welcome addition to the Insurance Program, and worth careful consideration.

The Plan offers a choice of monthly payments ranging from \$400 to \$1000 with lifetime accident and five year sickness benefits, and a choice of when these payments begin (on the 31st or 181st day of disability). A special feature guarantees a \$400 monthly benefit, payable up to two years for sickness or accident, to all members under 55 (subject to a limitation on pre-existing conditions) who apply during the Charter Enrollment Period.

Coverage remains in force regardless of changes in employment — even if the new job is a more hazardous one. And, as with the Life Insurance and Excess Major Medical Plans, members can take advantage of group rates.

Detailed information is being sent by the Administrator who will continue to service the Program. SIAM, MAA and AMS neither profit nor incur expense from this insurance and are presenting it solely for the benefit of members.

NOVEMBER MEETING OF THE INDIANA SECTION

The fall meeting of the Indiana Section of the MAA took place on Saturday, November 4, 1972, at DePauw University, Greencastle, with fifty-three persons in attendance, of whom forty-seven were MAA members.

The morning program consisted of talks by Professor P. S. Marcus, Indiana University at South Bend, on the topic, "Calculus Without Differentials," and by Professor M. D. Thompson, Indiana University, on "Model Building in Undergraduate Education."

A business meeting followed the luncheon. It was voted that pending approval of the revised by-laws for the Indiana Section, a registration fee of one dollar be instituted at each regular meeting, payable at the door. Professor Paul Mielke, Wabash, reported as Governor of the Indiana Section, and also as Chairman of the Section of Committee on Certification of Teachers in Indiana. The Section voted to continue this committee with its present membership (Professor A. Hallerbburg, Valparaiso, and Professor E. McKinney, Ball State) to keep the Section informed on developments as they arise. Professor Louis Cote, Purdue, spoke for the Editorial Committee, interpreting and urging support for the Indiana School Mathematics Journal. There was further discussion concerning the collection of experience in teaching methods in mathematics.

Following the business meeting, Professor R. P. Boas, Northwestern University, lectured on the topic "Consequences of Continuity."

R. T. HOOD, *Secretary-Treasurer*

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ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

Employment Information for Mathematicians

To cite this article: (1973) Employment Information for Mathematicians, *The American Mathematical Monthly*, 80:9, 1090-1091, DOI: [10.1080/00029890.1973.11993452](https://doi.org/10.1080/00029890.1973.11993452)

To link to this article: <https://doi.org/10.1080/00029890.1973.11993452>



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NEWS AND NOTICES

EDITED BY RAOUL HAILPERN, SUNY at Buffalo

Readers are invited to contribute to the general interest of this Department by sending news items to Mathematical Association of America, 1225 Connecticut Avenue, NW, Washington, D. C. 20036. Items must be submitted at least two months before publication can take place.

PERSONAL ITEMS

Rockford College: Assistant Professor David Brown, Stephens College, has been appointed Assistant Professor; Assistant Professor M. W. Potter has been promoted to Associate Professor.

Professor Howard Kleiman, Queensborough Community College, represented the Association at the inauguration of L. M. Goldstein as President of Kingsborough Community College on May 10, 1973.

Dr. R. W. Rector, Associate Director of Continuing Education in Engineering and Science at UCLA, has been appointed Executive Director of the American Federation of Information Processing Societies, Montvale, New Jersey.

Mr. Ronald J. Loring, State College at Boston, died on November 13, 1972, at the age of thirty-three. He was a member of the Association for five years.

Professor Emeritus Arthur D. Snyder, Union College, died on September 15, 1972, at the age of eighty-three. He was a Charter Member of the Association.

MATHEMATICAL ASSOCIATION OF AMERICA

Official Reports and Communications

EMPLOYMENT INFORMATION FOR MATHEMATICIANS

The 1973-74 academic year volume of EMPLOYMENT INFORMATION FOR MATHEMATICIANS will be available starting with the October 1973 issue. Subsequent issues will be published bi-monthly in December 1973, and February, April, June and July 1974.

Each issue will consist of four sections. The first section includes précis of all available positions submitted by the chairmen of departments in the mathematical sciences; the second section lists all such departments (colleges and universities) reporting no available positions; the third section consists of a geographical list of all departments that have not responded to the regularly distributed questionnaire; the fourth section includes information on governmental, industrial, and foreign positions as they are received. The foreword of each issue may include statistical data or articles concerning the job market from such sources as the NOTICES, the MONTHLY and committees, as well as a statistical analysis of the responses for a particular (or back) issue. The issues are mailed at the end of the month (approximately the 27th) in which they are published.

Information is collected from bi-monthly mailings to all chairmen of departments in the mathematical sciences who are on the master mailing list of the Society. Chairmen receive a preprinted return postcard on which they may provide information on available openings, or indicate that no openings are available. A statement that no positions are available may relieve the chairman of the obligation to answer letters from applicants, thus decreasing the burden of correspondence. This service will provide mathematicians with a comprehensive source of information on the employment situation six times a year.

The service is under the supervision of the Joint Committee on Employment Opportunities which includes the following members; R. D. Anderson, R. A. Handelsman, J. I. Rosenblatt (chairman), and W. N. Smith.

The price for individual subscribers to the **EMPLOYMENT INFORMATION FOR MATHEMATICIANS** is \$20 for the complete academic year. Single issues or back copies of EIM are not available. Subscription prices for departments are based on the number of doctorates granted; details may be obtained by writing to the Mathematical Sciences Employment Register, P. O. Box 6248, Providence, Rhode Island 02904. EIM is mailed via Second Class mail (normal delivery time to most points in the United States and Canada is two weeks) unless a subscriber indicates a willingness *in advance* to pay a service charge for First Class (\$2.50) or Airmail (\$3.50) delivery. Checks should be made payable to the American Mathematical Society and sent to the Mathematical Sciences Employment Register at the address given above.

APRIL MEETING OF THE INDIANA SECTION

The spring meeting of the Indiana Section, MAA, was held at Anderson College on Saturday, April 28, 1973, with 39 persons in attendance, including 34 members of the Association.

The morning program consisted of papers by Professor P. M. Harms, Taylor University, on "Real Function Rings," Professor G. L. Sherman, Rose-Hulman Institute of Technology, on "Probability in Group Theory," and Professor H. W. Alexander, Earlham College, on "Computer Augmented Instruction in Statistics." There followed a panel discussion on recent developments in the undergraduate program, led by Professor M. C. Gemignani, Indiana-Purdue at Indianapolis, consisting of Professors G. Springer, Indiana University, S. D. Conte, Purdue University, and P. T. Mielke, Wabash College.

A business meeting followed the luncheon. In addition to reports on current matters of interest to the MAA and the Indiana Section in particular, the members approved the appointment of candidates to serve on a state commission on science and technology, as provided for by a bill recently passed by the Indiana House of Representatives, this action to be implemented by the incoming chairman. Professor P. T. Mielke reported the approval of the Board of Governors of our proposed Section By-laws, subject to a few specific changes. As a result, it was agreed that the Indiana section would continue to collect funds in the manner traditional to it, by taking up a collection at each meeting. The section also voted to purchase a literature display kit from the MAA, and approved the award of gift subscriptions to the Monthly to Glenn Davis and P. M. Farmwald, top scorers from Indiana schools in the Putnam Competition. The Section voted that a letter of sympathy be sent to the family of Professor P. D. Edwards, Muncie, deceased, in appreciation for his many years of service to this section and to mathematics education in the state of Indiana.

Professor Mielke, representing the Nominating Committee, offered the following candidates for next year's section officers: Chairman, Professor E. H. McKinney, Ball State Univer-

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October Meeting of the Indiana Section

R. T. Hood (Secretary-Treasurer)

To cite this article: R. T. Hood (Secretary-Treasurer) (1974) October Meeting of the Indiana Section, *The American Mathematical Monthly*, 81:9, 1060-1060, DOI: [10.1080/00029890.1974.11993729](https://doi.org/10.1080/00029890.1974.11993729)

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Membership is open "to any person with interest in the history and philosophy of mathematics." Annual dues of \$4.00 were set for 1974 and 1975. *Historia Mathematica* was named the official journal of the Society, and members were offered the option of paying a single fee of \$10.00 for membership and subscription to the journal, starting with 1974 and Volume I. Those interested in membership should write to the Secretary-Treasurer, Professor J. L. Berggren, Mathematics Department, Simon Fraser University, Burnaby, British Columbia.

The first annual meeting was divided between sessions with the Canadian Society for the History and Philosophy of Science in connection with the Learned Societies Conference in Toronto (3-4 June) and with the Canadian Mathematical Congress at Laval University (7 June). In Toronto there was a joint meeting with the C.S.H.P.S./S.C.H.P.S. on the role of mathematics in the history of physical science, at which the speakers were J. L. Berggren, Stillman Drake, and H. S. M. Coxeter. There was also a session with papers by Tyrone Lai, Stephen Regoczei, Byron Wall, V. Linis, G. H. Moore, and P. K. Schotch. At Laval University there was a session with papers by Wei-Ching Chang, K. O. May, and G. H. Moore. In addition, H. Zassenhaus and E. A. Barbeau gave invited addresses on historical topics.

MATHEMATICAL ASSOCIATION OF AMERICA

Official Reports and Communications

OCTOBER MEETING OF THE INDIANA SECTION

The fall meeting of the Indiana Section of the MAA was held at Ball State University, Muncie, on Saturday, October 20, 1973, with approximately 120 persons in attendance.

The morning program consisted of papers by Professor M. A. Nyman, Manchester College, on "Some Remarks on a Generalization of Haar Series," and by Professor F. W. Owens, Ball State University, "On Some Graph Theoretical Research Problems from the Monthly." There followed a panel discussion on mathematics as viewed by representatives from business and industry, with Professor M. D. Thompson, Indiana University, as chairman, and consisting of Kenneth Clark, Lincoln National Life Insurance Co., Fort Wayne; Donald Holland, Operations Research Group, Detroit Diesel, Allison Division of General Motors, Indianapolis; David Sears, Computer Science-Numerical Analysis Division, General Motors, Indianapolis; and Lealon Tomkinson, Statistics Group, Eli Lilly Company, Indianapolis.

A business meeting followed the luncheon. In addition to reports on current plans of the MAA, the MAA High School Contest in Indiana, and the Indiana School Mathematics Journal, the members approved unanimously the motion of Professor M. C. Gemignani, Indiana-Purdue at Indianapolis, that the Section adopt a registration fee of one dollar at each meeting, with the proviso that the Executive Committee be delegated authority to exempt certain classes of attendants, such as speakers and students, from payment of this fee. In the absence of any news on the bill on science and technology, there was no report made.

An invited address followed on "Mass Balance and Interdisciplinary Models," by Professor Robert Pingry, Purdue University.

R. T. HOOD, *Secretary-Treasurer*

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The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

April Meeting of the Indiana Section

R. T. Hood (Secretary-Treasurer)

To cite this article: R. T. Hood (Secretary-Treasurer) (1974) April Meeting of the Indiana Section, *The American Mathematical Monthly*, 81:9, 1061-1061, DOI: [10.1080/00029890.1974.11993730](https://doi.org/10.1080/00029890.1974.11993730)

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APRIL MEETING OF THE INDIANA SECTION

The spring meeting of the Indiana Section of the MAA was held at Rose-Hulman Institute of Technology, Terre Haute, on Saturday, April 27, 1974, with approximately forty-five members present. The morning program consisted of the following papers: "A Constructive Theory of Completeness," by Professor John Lennes, Valparaiso University; "Newton's Power Sum Formula and Some Related Multisections," by Professor Clark Kimberling, Evansville University; "Fixed Point Iteration Using Infinite Matrices," by Professor B. E. Rhoades, Indiana University; "When do the Periodic Elements of a Group Form a Subgroup?" by Professor Gary Sherman, Rose-Hulman Institute.

Following lunch an MAA film was shown of an address by Professor R. H. Bing: "Some Challenging Conjectures." During the business meeting, Professor L. J. Cote was chosen to be the Indiana co-chairman of the MAA High School Contest for 1975. The formation of a speakers' bureau (of members who would be willing to speak at sister institutions) was discussed. Professor Harold Hanes, Earlham College, as chairman of the Nominating Committee, presented the following slate of officers for 1974-75 (which was unanimously approved): Chairman, Professor M. D. Thompson, Indiana University; Vice-chairman, Professor R. T. Hood, Franklin College; Secretary-Treasurer, Professor David Wilson, Wabash College.

Following the business meeting, Mr. Dale Van Laningham, a Rose-Hulman student and member of Pi Mu Epsilon, spoke on "The Sinbad Steamship Company: A Program to Schedule Freighter Traffic Optimally." An invited address followed, by Professor Casper Goffman, Purdue University: "Everywhere Convergence of Fourier Series."

R. T. Hood, *Secretary-Treasurer*

APRIL MEETING OF THE IOWA SECTION

The 61st regular meeting of the Iowa Section of the MAA was held at Upper Iowa University, Fayette, Iowa, on April 19, 1974. Chairman Donald Bailey presided. Total attendance was 33, including 32 members of the Section and one visitor from the Kansas Section.

Following the invited address, "Ramsey Theory and the Problem of Eccentric Hosts," by Seymour Schuster, Carleton College, and Governor Hogg's report, the business meeting was held. A progress report of the Visiting Lectures Program conducted by the Section was given by Chairman Bailey, and by general consent, it was agreed that we should continue the program. Attendance and ways to increase participation in the section affairs were discussed, but no definitive action was taken.

Lawrence Hart, Loras College, Dubuque, Iowa, was elected as Chairman-Elect.

The following contributed papers completed the program:

1. *Isoderivative curves*, by George Bridgman, Wartburg College.
2. *A mean value theorem for integrals*, by Donald Bailey, Cornell College.
3. *A simplified proof of Bezout's theorem*, by Arnold Adelberg, Grinnell College.
4. *A small college cooperative seminar*, by E. T. Hill, Cornell College.

B. E. GILLAM, *Secretary-Treasurer*

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ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

April Meeting of the Indiana Section

R. T. Hood (Secretary-Treasurer)

To cite this article: R. T. Hood (Secretary-Treasurer) (1974) April Meeting of the Indiana Section, *The American Mathematical Monthly*, 81:9, 1061-1061, DOI: [10.1080/00029890.1974.11993730](https://doi.org/10.1080/00029890.1974.11993730)

To link to this article: <https://doi.org/10.1080/00029890.1974.11993730>



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APRIL MEETING OF THE INDIANA SECTION

The spring meeting of the Indiana Section of the MAA was held at Rose-Hulman Institute of Technology, Terre Haute, on Saturday, April 27, 1974, with approximately forty-five members present. The morning program consisted of the following papers: "A Constructive Theory of Completeness," by Professor John Lennes, Valparaiso University; "Newton's Power Sum Formula and Some Related Multisections," by Professor Clark Kimberling, Evansville University; "Fixed Point Iteration Using Infinite Matrices," by Professor B. E. Rhoades, Indiana University; "When do the Periodic Elements of a Group Form a Subgroup?" by Professor Gary Sherman, Rose-Hulman Institute.

Following lunch an MAA film was shown of an address by Professor R. H. Bing: "Some Challenging Conjectures." During the business meeting, Professor L. J. Cote was chosen to be the Indiana co-chairman of the MAA High School Contest for 1975. The formation of a speakers' bureau (of members who would be willing to speak at sister institutions) was discussed. Professor Harold Hanes, Earlham College, as chairman of the Nominating Committee, presented the following slate of officers for 1974-75 (which was unanimously approved): Chairman, Professor M. D. Thompson, Indiana University; Vice-chairman, Professor R. T. Hood, Franklin College; Secretary-Treasurer, Professor David Wilson, Wabash College.

Following the business meeting, Mr. Dale Van Laningham, a Rose-Hulman student and member of Pi Mu Epsilon, spoke on "The Sinbad Steamship Company: A Program to Schedule Freighter Traffic Optimally." An invited address followed, by Professor Casper Goffman, Purdue University: "Everywhere Convergence of Fourier Series."

R. T. Hood, *Secretary-Treasurer*

APRIL MEETING OF THE IOWA SECTION

The 61st regular meeting of the Iowa Section of the MAA was held at Upper Iowa University, Fayette, Iowa, on April 19, 1974. Chairman Donald Bailey presided. Total attendance was 33, including 32 members of the Section and one visitor from the Kansas Section.

Following the invited address, "Ramsey Theory and the Problem of Eccentric Hosts," by Seymour Schuster, Carleton College, and Governor Hogg's report, the business meeting was held. A progress report of the Visiting Lectures Program conducted by the Section was given by Chairman Bailey, and by general consent, it was agreed that we should continue the program. Attendance and ways to increase participation in the section affairs were discussed, but no definitive action was taken.

Lawrence Hart, Loras College, Dubuque, Iowa, was elected as Chairman-Elect.

The following contributed papers completed the program:

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2. *A mean value theorem for integrals*, by Donald Bailey, Cornell College.
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B. E. GILLAM, *Secretary-Treasurer*

The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

November Meeting of the Indiana Section

D. E. Wilson (Secretary)

To cite this article: D. E. Wilson (Secretary) (1975) November Meeting of the Indiana Section, *The American Mathematical Monthly*, 82:9, 962-962, DOI: [10.1080/00029890.1975.11993991](https://doi.org/10.1080/00029890.1975.11993991)

To link to this article: <https://doi.org/10.1080/00029890.1975.11993991>



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Official Reports and Communications

NOVEMBER MEETING OF THE INDIANA SECTION

The fall meeting of the Indiana Section of the MAA was held at Indiana University-Purdue University at Indianapolis, on Saturday, November 30, 1974, with approximately 60 persons in attendance. The Chairman of the Section, Maynard Thompson of Indiana University, presided.

S. Abhyanker of Purdue University gave the invited address, "Historical Ramblings in Algebraic Geometry and Related Algebra."

The following papers were presented:

1. *Cohomology with multiple-valued functions applied to fixed point theory*, by T. J. Wroosz, Wabash College.
2. *On a new definition of the Lebesgue integral*, by Herman Rubin, Purdue University.
3. *On the improvement of convergence of certain series*, by A. K. Naghdi, IUPUI.
4. *Giffen's paradox or an exercise in multivariate calculus*, by David Bash, Purdue University, Fort Wayne.
5. *Irreducible factors of various polynomials*, by Clark Kimberling, University of Evansville.
6. *Abstract algebra and finite-state machines*, by Judith Gersting, IUPUI.
7. *Distribution theory — an example of the evolution of a mathematical concept*, by John Synowiec, Indiana University Northwest.
8. *On the transfer homomorphism*, by Larry Schiefelbusch, Indiana University Northwest.
9. *Extensions of Haar measure to a nonmeasurable subgroup of finite index*, by H. L. Peterson, Indiana University Northwest.
10. *Rest points, tangent circles, and the rational number line*, by R. T. Hood, Franklin College.

During the lunch break, the film, "Regular Homotopies in the Plane," was shown.

D. E. WILSON, *Secretary*

APRIL MEETING OF THE INDIANA SECTION

The spring meeting of the Indiana Section of the MAA was held at Purdue University, Fort Wayne, on Saturday, April 26, 1975, with approximately 45 persons in attendance. The Chairman of the Section, Maynard Thompson of Indiana University, presided.

The invited addresses were:

1. *Some new thoughts on teaching statistics*, by Meyer Dwass, Northwestern University.
2. *Langford sequences*, by D. P. Roselle, Virginia Polytechnic Institute.

The following papers were presented:

1. *Local degree computation by methods direct and devious*, by D. R. McCarthy, Purdue University, Fort Wayne.
2. *Networks as models for human behavior*, by R. D. Ringisen, Purdue University, Fort Wayne.

L. J. Cote, Purdue University, awarded prizes to Laura Chihara, Highland High School, and R. A. Dwyer, Yorktown High School, for solving problems appearing in the Indiana School Mathematics Journal.

During the lunch break, the film, "Unsolved Problems (Victor Klee)," was shown.

At the business meeting, memberships in the MAA were awarded to J. H. Boyd III, Indiana University, and R. S. Gumerlock, Notre Dame, in recognition of their performances on the Putnam examination.

P. T. Mielke, Wabash College, gave the Governor's report, and Maynard Mansfield, Purdue University, Fort Wayne, was introduced as the new Governor of the Section.

Earl McKinney, Ball State University, as chairman of the Nominating Committee, presented the following slate of officers for 1975-76 (which was unanimously approved): Chairman, R. T. Hood, Franklin College; Vice-Chairman, M. C. Gemignani, Indiana University-Purdue University at Indianapolis; Secretary-Treasurer, D. E. Wilson, Wabash College.

D. E. WILSON, *Secretary*

The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

April Meeting of the Indiana Section

D. E. Wilson (Secretary)

To cite this article: D. E. Wilson (Secretary) (1975) April Meeting of the Indiana Section, *The American Mathematical Monthly*, 82:9, 962-962, DOI: [10.1080/00029890.1975.11993992](https://doi.org/10.1080/00029890.1975.11993992)

To link to this article: <https://doi.org/10.1080/00029890.1975.11993992>



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Official Reports and Communications

NOVEMBER MEETING OF THE INDIANA SECTION

The fall meeting of the Indiana Section of the MAA was held at Indiana University-Purdue University at Indianapolis, on Saturday, November 30, 1974, with approximately 60 persons in attendance. The Chairman of the Section, Maynard Thompson of Indiana University, presided.

S. Abhyanker of Purdue University gave the invited address, "Historical Ramblings in Algebraic Geometry and Related Algebra."

The following papers were presented:

1. *Cohomology with multiple-valued functions applied to fixed point theory*, by T. J. Wroosz, Wabash College.
2. *On a new definition of the Lebesgue integral*, by Herman Rubin, Purdue University.
3. *On the improvement of convergence of certain series*, by A. K. Naghdi, IUPUI.
4. *Giffen's paradox or an exercise in multivariate calculus*, by David Bash, Purdue University, Fort Wayne.
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10. *Rest points, tangent circles, and the rational number line*, by R. T. Hood, Franklin College.

During the lunch break, the film, "Regular Homotopies in the Plane," was shown.

D. E. WILSON, *Secretary*

APRIL MEETING OF THE INDIANA SECTION

The spring meeting of the Indiana Section of the MAA was held at Purdue University, Fort Wayne, on Saturday, April 26, 1975, with approximately 45 persons in attendance. The Chairman of the Section, Maynard Thompson of Indiana University, presided.

The invited addresses were:

1. *Some new thoughts on teaching statistics*, by Meyer Dwass, Northwestern University.
2. *Langford sequences*, by D. P. Roselle, Virginia Polytechnic Institute.

The following papers were presented:

1. *Local degree computation by methods direct and devious*, by D. R. McCarthy, Purdue University, Fort Wayne.
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D. E. WILSON, *Secretary*

The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

November Meeting of the Indiana Section

D.E. Wilson (Secretary)

To cite this article: D.E. Wilson (Secretary) (1976) November Meeting of the Indiana Section, *The American Mathematical Monthly*, 83:7, 589-589, DOI: [10.1080/00029890.1976.11994179](https://doi.org/10.1080/00029890.1976.11994179)

To link to this article: <https://doi.org/10.1080/00029890.1976.11994179>



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NOVEMBER MEETING OF THE INDIANA SECTION

The fall meeting of the Indiana Section of the MAA was held at Valparaiso University at Valparaiso, on Saturday, November 15, 1975, with approximately 50 persons in attendance. The Chairman of the Section, Rodney Hood of Franklin College, presided.

Chairman Hood initiated the custom of an inaugural address with the topic, "Rest Points and Tangent Spheres."

The following papers were presented:

1. *A probabilistic estimate of normality*, by G.J. Sherman, Rose-Hulman Institute of Technology.
2. *Convergence theorems for sequences of nonlinear semigroups on Banach Spaces*, by Yen Tzu Fu, Indiana State University, Evansville.
3. *Individualization in the calculus course*, by D.L. Neuhauser, Taylor University.
4. *Indiana House Bill 246, 1897, revisited*, by A.E. Hallerberg, Valparaiso University.
5. *Some applications of n-person Cooperative Games*, by John Sorenson, Valparaiso University.

At the business meeting Maynard Mansfield, Purdue University, Fort Wayne, gave the Governor's report, and Duane Deal, Ball State University, urged members to write Governor Otis Bowen concerning Rules 46 and 47 for teacher certification.

D.E. WILSON, *Secretary*

NOVEMBER MEETING OF THE MARYLAND-DISTRICT OF COLUMBIA - VIRGINIA SECTION

The annual Fall meeting of the Maryland-District of Columbia-Virginia Section of the MAA was held November 22, 1975, at Georgetown University, Washington, D.C. One hundred seven persons attended of whom ninety-nine were members of the Association. Professor Ronald Davis, chairman of the Section, presided.

During the morning session there were contributed papers and a short business meeting. Following lunch, there were additional contributed papers and an invited speaker. The invited speaker, Dr. Leon Greenberg of the University of Maryland, presented a talk titled "Groups and Riemann Surfaces."

The contributed papers presented were:

1. *Mathematics of Flatland Mirrors*, by W.A. Barwick, Jr., College Park, Maryland.
2. *Placement and Prescription: Another approach to individualized instruction*, by William Steger, Essex Community College.
3. *Here's the Last Flaw*, by C.J. Maloney, Bethesda, Maryland.
4. *Mathematics in Colonial America*, by Sister Marie Augustine Dowling, College of Notre Dame of Maryland.
5. *The relationship between multinomials and nth dimensional Pascal's Spaces*, by A.P. Crotts, Jr., Georgetown University.
6. *A mathematics preparatory program for minority students: a post-mortem examination*, by S.E. Goodman, University of Virginia.
7. *A note on Nim*, by B.L. Schwartz, Department of the Navy.
8. *A course in the application of mathematics: A model building approach*, by D.C. Cathcart, Salisbury State College.
9. *Variously restricted occupancy theory, or, how (unrestricted) formal "communes" may facilitate mathematical education*, by John Hays, Reston, Virginia.
10. *Optimal allocation of inspection resources*, by Martin Pearl, National Bureau of Standards.
11. *A linear algebra approach to non-stationary Markov Chains*, by J.C. Hennessey, Loyola College.
12. *Some aspects of gambling*, by Anthony Mucci, University of Maryland.
13. *Algorithms for transit information*, by Judith F. Gilsinn, National Bureau of Standards.
14. *How to trivialize many results in topology*, by R.A. Herrmann, U.S. Naval Academy.
15. *Two notes on numerical integration*, by T.S. Schreiber, Fairfax, Virginia.

J.M. SMITH, *Secretary*

NOVEMBER MEETING OF THE PHILADELPHIA SECTION

The fiftieth annual meeting of the Philadelphia Section of the MAA was held at Franklin and Marshall College, Lancaster, Pennsylvania, on November 22, 1975. The Section Chairman, Professor Eugene Klotz, presided at the meeting. A total of 135 persons attended, including 108 members of the Association.

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The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

May Meeting of the Indiana Section

D. E. Wilson (Secretary)

To cite this article: D. E. Wilson (Secretary) (1976) May Meeting of the Indiana Section, The American Mathematical Monthly, 83:9, 767-767, DOI: [10.1080/00029890.1976.11994244](https://doi.org/10.1080/00029890.1976.11994244)

To link to this article: <https://doi.org/10.1080/00029890.1976.11994244>



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elect, Professor Therese Butzen of William Rainy Harper College was elected First Vice-Chairman, and Professor H. C. Saar was re-elected Secretary-Treasurer.

H. C. SAAR, *Secretary-Treasurer*

MAY MEETING OF THE INDIANA SECTION

The spring meeting of the Indiana Section of the MAA was held at Franklin College, Franklin, on Saturday, May 1, 1976, with approximately 40 persons in attendance. The Chairman of the Section, Rodney Hood of Franklin College, presided.

The program consisted of the following:

1. *Some simple computations*, by P. T. Joshi, Ball State University.
2. *Are we off the track?*, by G. N. Wollan, Purdue University.
3. *Islamic art and mathematics*, by H. W. Alexander, Earlham College.
4. Film: *John von Neumann*.
5. *Some bridges to and from mathematics*, by A. B. Willcox, Executive Director of the MAA.

L. J. Cote, Purdue University, awarded prizes for solving problems appearing in the Indiana School Mathematics Journal to Richard Dukes, Crispus Attucks High School; Rex Dwyer, Yorktown High School; Mark Lasky, Valparaiso High School; Steve Neumann, Highland High School; and Randy Strommer, Arlington High School.

At the business meeting, memberships in the MAA were awarded to M. C. Ng, Purdue University, and A. N. Srivastava, Indiana University, in recognition of their performances on the Putnam examination.

Maynard Thompson, Indiana University, as chairman of the Nominating Committee, presented the following slate of officers for 1976-77 (which was unanimously approved): Chairman, M. C. Gemignani, Indiana University-Purdue University at Indianapolis; Vice-Chairman, G. J. Sherman, Rose-Hulman Institute of Technology; Secretary-Treasurer, D. E. Wilson, Wabash College.

D. E. WILSON, *Secretary*

MAY MEETING OF THE MICHIGAN SECTION

The annual meeting of the Michigan Section of the MAA was held at Calvin College, Grand Rapids, on May 7-8, 1976. Attendance continued to be high. Despite a conflict with final examinations or other events at certain colleges and the closeness of the forthcoming graph theory conference at Western Michigan University, approximately 150-160 persons, representing most of the state's four-year colleges and several two-year ones, attended the sessions.

In formulating the plans for the meeting, the Program Committee took note of the strong interest in applied mathematics and the role of mathematics in business and industry demonstrated by member colleges following last year's annual meeting in Flint which featured seminars with mathematicians from industry. Some more speakers from industry were invited for that express purpose. The Program Committee also planned some talks that reflected the Centennial (Calvin College is celebrating its Centennial this year) and Bicentennial theme as well as sessions that would be of special interest to the two-year colleges. Dr. Louis DiBello of Computer-Based Education Research Laboratory of the University of Illinois made a presentation of the PLATO Math Project which is used to assist in mathematics instruction via computer and television in nine community colleges in the Chicago area. Dr. Phillip Jones of the University of Michigan reminisced over the events that happened to mathematics curricula and mathematicians in the state of Michigan in his banquet address, at the end of which he donated to the Section a box of coins which he had collected over the years as treasurer of various mathematical associations.

At the business meeting, Professor C. B. Stortz, chairperson of the Michigan Section, made the following announcements: (1) The Michigan Section has been in contact with the Michigan Academy of Science, Arts and Letters over the possibility of holding a meeting at the same time if the opportune moment presents itself. (2) The next Annual Meeting of the Section will be held at Eastern Michigan University on May 6 and 7, 1977. (3) There have been two invitations from member institutions to host the 1978 and 1979 meetings, but the Section hopes to hold its meetings at different parts of the state and welcomes invitations from colleges located outside of the southeastern part of the state. (4) The *Mathematics Magazine* has a new format and copies of the magazine were prominently displayed. (5) The biannual summer seminar to be held at Marquette will focus on operations research.

The secretary-treasurer reported on the financial status of the Section and read part of the letter from Dr.

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The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

November Meeting of the Indiana Section

D. E. Wilson (Secretary)

To cite this article: D. E. Wilson (Secretary) (1977) November Meeting of the Indiana Section, *The American Mathematical Monthly*, 84:7, 592-592, DOI: [10.1080/00029890.1977.11994425](https://doi.org/10.1080/00029890.1977.11994425)

To link to this article: <https://doi.org/10.1080/00029890.1977.11994425>



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NEW SECTIONAL GOVERNORS OF THE ASSOCIATION

The following have been elected Governors of the Association representing the Sections indicated:

FLORIDA	C. W. McArthur, Florida State University
ILLINOIS	Jon M. Laible, Eastern Illinois University
INTERMOUNTAIN	William J. Coles, University of Utah
IOWA	James L. Cornette, Iowa State University
LOUISIANA-MISSISSIPPI	Thomas A. Atchison, Mississippi State University
MARYLAND-DC-VIRGINIA	Theodore J. Benac, U. S. Naval Academy
MICHIGAN	Yousef Alavi, Western Michigan University
NORTH CENTRAL	Warren S. Loud, University of Minnesota
PHILADELPHIA	Jerry P. King, Lehigh University
SOUTHERN CALIFORNIA	Alicia A. Huffman, California State Polytechnic University
TEXAS	James N. Younglove, University of Houston

The highest percentage of voters was 43%, occurring in the Iowa Section. The Intermountain Section was the runner-up with 36%.

A. B. WILLCOX, *Executive Director*

SUGGESTION BOX

Members of the MAA are encouraged to send in suggestions, questions, etc., about the operations of the Association. Communications will be referred to the appropriate officer of the Association for answering; from time to time, those of general interest may also be answered in one or both of the official journals. Communications should be addressed to: Suggestion Box, Mathematical Association of America, 1225 Connecticut Avenue, N. W., Washington, D. C. 20036.

NOVEMBER MEETING OF THE INDIANA SECTION

The fall meeting of the Indiana Section of the MAA was held at Manchester College, North Manchester, on Saturday, November 6, 1976, with approximately 60 persons in attendance. The Chairman of the Section, M. C. Gemignani, IUPUI-at Indianapolis, presided.

The program consisted of the following:

1. *Remedial mathematics: an administrator's viewpoint*, by M. C. Gemignani, IUPUI.
2. *A glimpse of algebraic number theory, parts I and II*, by B. Pollak, Notre Dame.
3. *Panel discussion on the new State Bulletin concerning Teacher Education*. Panelists: E. Alton, IUPUI; D. Deal, Ball State; P. Nugent, Franklin College.

After the panel discussion the Section took the following actions:

Passed. *Resolution I*: Those electing the science area will be eligible to teach mathematics only if 24 hours are completed in mathematics equivalent to the mathematics minor.

Passed. *Resolution II*: A provision shall be made for a computer science endorsement that can be added to a license with a mathematics or science teaching major. This endorsement would permit a teacher to teach computer science, computer language, and computer literacy courses.

Endorsed. Recommendations of The Indiana Mathematics Educators for Teacher Certification Programs regarding mathematics requirements.

D. E. WILSON, *Secretary*

NOVEMBER MEETING OF THE NORTHEASTERN SECTION

The twenty-second annual meeting of the Northeastern Section of the MAA was held at Rhode Island College, Providence, Rhode Island, on November 27, 1976; there were 91 people in attendance. The section chairman, Grattan Murphy, presided.

The morning meeting was devoted to a panel discussion: *High School Preparation for College Mathematics Courses*, Moderator: R. D. Klein, Northeastern University; panelists: Arthur Bardige, Arlington, Massachusetts



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

May Meeting of the Indiana Section

D.E. Wilson (Secretary-Treasurer)

To cite this article: D.E. Wilson (Secretary-Treasurer) (1978) May Meeting of the Indiana Section, *The American Mathematical Monthly*, 85:1, 69-69, DOI: [10.1080/00029890.1978.11994517](https://doi.org/10.1080/00029890.1978.11994517)

To link to this article: <https://doi.org/10.1080/00029890.1978.11994517>



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Chairman John Christiano presided. Dr. Henry Alder, President of the Association, was our honored guest and keynote speaker at the annual banquet.

Invited addresses from Professor Robert Troyer of Lake Forest College on "Infinitesimal Calculus," and from Professor Vera Pless of University of Illinois at Chicago Circle on "Women in Mathematics" were presented. Other sessions and their topics included:

Ambiguity and indetermination for functions defined in a disk, by Peter Colwell, Iowa State University.

Instructional materials for intermediate algebra, by Al Otto, Illinois State University; John Bradburn, Elgin Community College; Ray Moehrlin, William Rainey Harper College.

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H. C. SAAR, *Secretary*

MAY MEETING OF THE INDIANA SECTION

The spring meeting of the Indiana Section of the MAA was held at Wabash College at Crawfordsville on Saturday, April 30, 1977, with approximately 90 persons in attendance. The Chairman of the Section, M.C. Gemignani of IU-PU-Indianapolis, presided over a program celebrating Gauss' 200th birthday.

The following papers were presented:

1. *Gauss: His life and times*, by P.T. Mielke, Wabash College.
2. *Infinite series from a contemporary point of view I*, by R.P. Boas, Northwestern University.
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L.J. Cote, Purdue University, recognized James Keller, North Side High School, Fort Wayne, for solving problems appearing in the Indiana School Mathematics Journal.

At the business meeting Harold Hanes, Earlham College, as chairman of the Nominating Committee, presented the following slate of officers for 1977-78 (which was unanimously approved): Chairman, G.J. Sherman, Rose-Hulman Institute of Technology; Vice-Chairman, M. Jerison, Purdue University; Secretary-Treasurer, D.E. Wilson, Wabash College.

Memberships in the MAA were awarded to R.M. Priem and R.A. Strickland, both of Rose-Hulman Institute of Technology, in recognition of their performances on the Putnam examination.

D.E. WILSON, *Secretary-Treasurer*

MAY MEETING OF THE MICHIGAN SECTION

Approximately 100-120 persons attended the Annual Meeting of the Michigan Section on May 6 and 7, 1977, at Eastern Michigan University in Ypsilanti, Michigan.

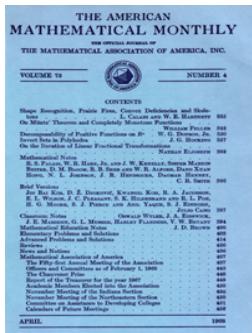
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Dr. A.B. Willcox, Executive Director of the MAA, was an active participant of this year's meeting. He held a rap session with members during the Business Meeting to answer questions and comments. The following day he gave the closing address. Members enjoyed meeting our Executive Director and found his talks stimulating.

Professor J.S. Frame, who will be retiring from Michigan State University this year, was honored with the presentation of a certificate of resolution recognizing his numerous contributions to the Michigan Section and to the mathematical community at large.

In keeping with the Section practice of inviting speakers from out of state to our annual meetings, we are particularly pleased to report the excellent talks given by Dr. James Roseblade, Cambridge University, England, and Dr. Jack Hale, Brown University.

The following persons were elected to be officers of the Michigan Section for 1977-78: Chairperson: J.E.



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

November Meeting of the Indiana Section

M. J. Mansfield (Secretary-Treasurer)

To cite this article: M. J. Mansfield (Secretary-Treasurer) (1968) November Meeting of the Indiana Section, *The American Mathematical Monthly*, 75:4, 450-450, DOI: [10.1080/00029890.1968.11971008](https://doi.org/10.1080/00029890.1968.11971008)

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ACADEMIC MEMBERS ELECTED INTO THE ASSOCIATION

In accordance with the amendment adopted at the business meeting of the Association at Stillwater on August 30, 1961, the Board of Governors at its meeting in San Francisco, California, on January 24, 1968, elected to membership the thirteenth set of applicants for academic membership (for election of the other twelve sets, see the April and November issues for 1962-67). Approval for election was given to the following 3 applicants for academic membership:

Spartanburg Jr. College, Spartanburg, South Carolina
 State University College at Oswego, Oswego, New York
 West Virginia University, Morgantown, West Virginia

HENRY L. ALDER, *Secretary*

NOVEMBER MEETING OF THE INDIANA SECTION

The fall meeting of the Indiana Section of the MAA was held on November 11, 1967 at Marian College in Indianapolis, Indiana. There were 112 persons in attendance, including 70 members of the Association.

The Right Reverend Monseigneur F. J. Reine, President of Marian College, welcomed the group. Professor K. J. Sidebottom, Chairman of the Section, presided.

At the business meeting, Professor Sidebottom reported some of the highlights of the Meeting of Section Officers at the University of Toronto, August 28, 1967. Professor B. E. RHOADES described the GUIDEBOOK and suggested some uses to which it might be put. Professor J. C. Polley announced that he was turning over to the Executive Committee of the Section a nearly complete set of the minutes of the Indiana Section; Professor P. D. Edwards suggested that the Committee might investigate the possibility of depositing the minutes in the Indiana State Library. Professor Earl McKinney reported on arrangements for the spring meeting of the Section, to be held in conjunction with the Indiana Council of Teachers of Mathematics at Ball State University on May 4, 1968.

The following program was presented:

1. *On the inadequacy of sequences*, by J. B. Conway, Indiana University.
2. *Counting n-dimensional trees*, by R. E. Pippert, Purdue University, Ft. Wayne.
3. *Some ovals I have known*, by H. Flanders, Purdue University.
4. *Non-standard models*, by A. Adler, Indiana University.
5. *Some seldom-mentioned non-measurable sets*, by R. P. Miller, Ball State University.
6. *Graphs and matrices*, by L. W. Beineke, Purdue University, Ft. Wayne.

M. J. MANSFIELD, *Secretary-Treasurer*

NOVEMBER MEETING OF THE NORTHEASTERN SECTION

The thirteenth annual meeting of the Northeastern Section of the MAA was held at Phillips Academy, Andover, Massachusetts, on November 25, 1967. The registered attendance was 110, including 92 members of the Association. Chairman Robin Robinson of Dartmouth College presided at both the morning and afternoon sessions.

At the business meeting a nominating committee consisting of M. E. Munroe, Chairman, D. W. Blackett, and C. E. Richart proposed the following slate of officers for the coming year: Chairman, Guilford Spencer, II, Williams College; Vice-Chairman, W. S. H. Crawford, Mount Allison University; Secretary-Treasurer, G. W. Best, Phillips Academy. The slate was elected unanimously. A motion was also passed which



The American Mathematical Monthly

ISSN: 0002-9890 (Print) 1930-0972 (Online) Journal homepage: <https://maa.tandfonline.com/loi/uamm20>

May Meeting of the Indiana Section

D.E. Wilson (Secretary-Treasurer)

To cite this article: D.E. Wilson (Secretary-Treasurer) (1978) May Meeting of the Indiana Section, *The American Mathematical Monthly*, 85:1, 69-69, DOI: [10.1080/00029890.1978.11994517](https://doi.org/10.1080/00029890.1978.11994517)

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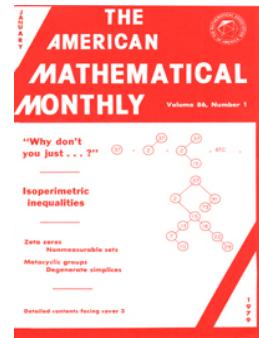
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Mathematical Association of America

Gus Mavrigian (Secretary-Treasurer) & D. Wilson (Secretary-Treasurer)

To cite this article: Gus Mavrigian (Secretary-Treasurer) & D. Wilson (Secretary-Treasurer) (1979) Mathematical Association of America, *The American Mathematical Monthly*, 86:1, 75-76, DOI: [10.1080/00029890.1979.11994737](https://doi.org/10.1080/00029890.1979.11994737)

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OCTOBER MEETING OF THE OHIO SECTION

The Ohio Section of MAA held its Fall meeting at Ohio Northern University, Ada, Ohio, October 20 and 21, 1978. Approximately one hundred and fifty people were in attendance. Section Chairperson M.D. Wetzel presided; C.A. Long was the Program Chairman.

Invited addresses included: *Numerical Instabilities and Their Cure*, by W.S. Dorn, University of Denver; and *Numerical Analysis—The State of the Art*, by R.S. Varga, Kent State University.

The following contributed papers were also presented:

Hilbert Polynomials, D.D. Berry, Wittenberg College

Numerical Solution to Differential Equations, J.C. Hintz, University of Akron

On Normal Sylow Subgroups, D.J. Horwath, John Carroll University

Computing Output Distributions of Stochastic Systems, C. Looney, University of Toledo

An Algorithm for the Characteristic Polynomial of a Matrix, W.A. McWorter, Jr., Ohio State U.

Minimum Two-Impulse Velocity Correction for a Space Probe, J.R. Michel, Marietta College

Orthogonal Polynomials for Non-Classical Weight Functions, T.E. Price, Jr., University Akron

Calculator Calculus at Ohio State, J. Riedl and H. Allen, Ohio State University

A Very Elementary Computer Model Based on the Brachistochrone Problem, L.J. Schneider, John

Carroll University

Conjugate Direction Algorithms in Numerical Analysis and Optimization, J. Stein, Univ. Toledo

Numerical Methods in Finding Optimal Experimental Designs, J-Y Tsay, University of Cincinnati

What Can a Pocket Programmable Do for You in Numerical Analysis? W.C. Weber, Bowling Green U.

The meeting agenda also included meetings of the Executive Committee, of MAA Ohio Section Campus Representatives, of mathematics department chairpersons for state supported institutions, and of ad hoc committees: Committee on Co-operation Among Colleges and Universities, Committee on Curriculum, and Committee on Teacher Training and Certification.

Meeting highlights included discussion sessions. A *Panel Discussion on Numerical Methods in Mathematics—Teaching, Research, and Industry* was led by W.S. Dorn, University of Denver; D.O. Norris, Ohio University (moderator); I. Shavitt, Battelle Memorial Institute, Columbus; and R.S. Varga, Kent State University. 'Swap' sessions included: *Numerical Methods in Teaching Calculus*, led by J.C. Hintz, University of Akron; and *Collective Bargaining and Its Effect on Teaching and Research*, led by M. Levine, University of Cincinnati.

Section officers for academic year 1978-79 are: M.D. Wetzel, Dennison University, Chairperson; D.O. Koehler, Miami University, Chairman-Elect; W.H. Byer, University of Akron, Past Chairman; G. Mavrigian, Youngstown State University, Secretary-Treasurer; C.A. Long, Bowling Green State U., Program Chairman; H.W. Vayo, University of Toledo and D.J. Horwath, John Carroll University, Program Committee Members. Also, R.L. Wilson, Ohio Wesleyan University, serves as Sectional Governor; S.W. Hahn, Wittenberg University, as MAA representative on the Committee-On-Sections; L.J. Schneider, John Carroll University, as Supervisor of the MAA High School Mathematics Competition; C.F. Yang, Miami University, Middletown Campus, as representative to the Two-Year College Mathematics Journal; and R.A. Little, Baldwin-Wallace College, as Section Newsletter Editor.

GUS MAVRIGIAN, *Secretary-Treasurer*

OCTOBER MEETING OF THE INDIANA SECTION

The fall meeting of the Indiana Section of the MAA was held at Marian College at Indianapolis on Saturday, October 28, 1978, with approximately 50 persons in attendance. The chairman of the Section, M. Jerison of Purdue University, presided.

The following papers were presented:

The Goldbach conjecture, U. Dudley, DePauw University

Fractals - objects with curious dimensions, M. Jerison, Purdue University

If the axiom of choice were false, A. Blass, Universities of Michigan and Wisconsin

Panel discussion on how calculators will change the school mathematics curriculum. Panelists: G. Wheatley, Purdue University; J. McIntosh, Indiana University

At the business meeting it was decided to continue the tradition of one year of holding the spring meeting in conjunction with the Friendly Math Competition.

D. WILSON, *Secretary-Treasurer*

CALENDAR OF FUTURE MEETINGS

Sixty-second Annual Meeting, Biloxi, Mississippi, January 26-28, 1979.
Fifty-ninth Summer Meeting, University of Minnesota, Duluth, August 21-23, 1979.
The following is a list of the Sections of the Association with dates of future meetings so far as they have been reported to the Editorial Director.

- ALLEGHENY MOUNTAIN, last weekend in April or first weekend in May. Deadline for papers 6 weeks before meeting.
- FLORIDA, early March. Deadline for paper titles 2 weeks before meeting.
- ILLINOIS, first Friday/Saturday in May.
- INDIANA
- INTERMOUNTAIN
- IOWA, third weekend in April. Deadline for papers February 1.
- KANSAS, Johnson County Community College, Overland Park, April 7, 1979.
- KENTUCKY, early April. Deadline for papers 6 weeks before meeting.
- LOUISIANA-MISSISSIPPI, Friday-Saturday before February 20. Deadline for papers 3 months before meeting.
- MARYLAND-DISTRICT OF COLUMBIA-VIRGINIA, Saturday before Thanksgiving and last Saturday in April.
- METROPOLITAN NEW YORK, Adelphi University, May 5, 1979.
- MICHIGAN, first Friday and Saturday in May. Deadline for papers 6 weeks before meeting.
- MISSOURI, late March/early April. Deadline for papers January 31.
- NEBRASKA, April.
- NEW JERSEY, early November and early May.
- NORTH CENTRAL, end of October and April. Deadline for papers October 1 and April 1.
- NORTHEASTERN, Saturday after Thanksgiving, and third week in June in odd-numbered years.
- NORTHERN CALIFORNIA, Sonoma State University, Rohnert Park, February 24, 1979.
- OHIO, Miami University, Middletown, April 20-21, 1979.
- OKLAHOMA-ARKANSAS, Oklahoma State University, Stillwater, March 30-31, 1979.
- PACIFIC NORTHWEST, University of British Columbia, Vancouver, June 15-16, 1979.
- PHILADELPHIA, Saturday before Thanksgiving.
- ROCKY MOUNTAIN, University of Denver, Denver, April 27-28, 1979.
- SEAWAY, first Saturday in November and Saturday in late April. Deadline for papers 6 weeks before meeting.
- SOUTHEASTERN, University of Tennessee, Chattanooga, April 6-7, 1979.
- SOUTHERN CALIFORNIA, first or second Saturday in March.
- SOUTHWESTERN, usually in April. Deadline for papers 2 weeks before meeting.
- TEXAS, Friday and Saturday in early April. Deadline for papers March 1.
- WISCONSIN, Friday and Saturday between mid-April and first week in May. Deadline for papers 6 weeks before meeting.

FUTURE MEETINGS OF OTHER ORGANIZATIONS

- AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, Houston, Texas, January 3-8, 1979.
- AMERICAN MATHEMATICAL ASSOCIATION OF TWO YEAR COLLEGES
- AMERICAN MATHEMATICAL SOCIETY, Biloxi, Mississippi, January 24-27, 1979.
- AMERICAN SOCIETY FOR ENGINEERING EDUCATION
- ASSOCIATION FOR COMPUTING MACHINERY, Plaza Hotel, Detroit, Michigan, October 29-31, 1979.
- ASSOCIATION FOR SYMBOLIC LOGIC, Biloxi, Mississippi, January 24-25, 1979.
- ASSOCIATION FOR WOMEN IN MATHEMATICS
- CANADIAN SOCIETY FOR HISTORY AND PHILOSOPHY OF MATHEMATICS/SOCIÉTÉ CANADIENNE D'HISTOIRE ET DE PHILOSOPHIE DES MATHÉMATIQUES
- FIBONACCI ASSOCIATION
- INSTITUTE OF MATHEMATICAL STATISTICS, Washington, D.C., August 13-16, 1979.
- MU ALPHA THETA
- NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS, Boston, Massachusetts, April 18-21, 1979.
- OPERATIONS RESEARCH SOCIETY OF AMERICA, Hyatt Regency Hotel, New Orleans, Louisiana, April 29-May 1, 1979.
- PI MU EPSILON
- SCHOOL SCIENCE AND MATHEMATICS ASSOCIATION, Radisson Muehlbach, Kansas City, Missouri, November 8-10, 1979.
- SOCIETY FOR INDUSTRIAL AND APPLIED MATHEMATICS

October Meeting of the Indiana Section

Source: *The American Mathematical Monthly*, Vol. 88, No. 1 (Jan., 1981), p. 83

Published by: Taylor & Francis, Ltd. on behalf of the Mathematical Association of America

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MATHEMATICAL ASSOCIATION OF AMERICA

Official Reports and Communications

OCTOBER MEETING OF THE OHIO SECTION

The Ohio Section of MAA held its fall meeting at John Carroll University, University Heights, Ohio, October 17-18, 1980. One hundred and forty-five people registered for the meeting. Section Chairman C.A. Long presided; DJ. Horwath was the program chairman.

Invited addresses included: *Recent Implications of the Work of L.J. Rogers*, by G.E. Andrews, The Pennsylvania State University; and *An Introduction to Coding Theory*, by D.K. Ray-Chaudhuri, the Ohio State University

The following contributed papers were also presented:

- Bayes' Discrete Data Analysis*, J. Albert and A. Gupta, Bowling Green State University
A Report on (P and Q) Polynomial Association Schemes, E. Bannai, Ohio State University
Projective Concepts in Torsion Theories, A. Benander, John Carroll University
Finite Sigma-length in Torsion Theories, A. Benander, John Carroll University
Experiments in the Classroom—Using "Dots" to Determine Area, K.B. Cummins, Kent State University
A Model of Epidemics in Third World Children, P.J. Gingko, University of Akron
Regular Graphs with Small Excess, T. Ito, Ohio State University
A Finite Mathematics Problem Arising from Multiprocessing, Sr. T.M. McCloskey, Notre Dame College
Centers and Centroids in Graphs, Z. Miller, Miami University
Automorphism Groups of Graphs with Pendant Vertices and the Ulam Graph Reconstruction Problem, N. Robertson, Ohio State University
6-Flows on Graphs, P.D. Seymour, Ohio State University
Glimpses of Malawi, Africa, J.L. Smith, Muskingum College
Finite Optimization Algorithms in Operations Research and Graph Theory, D. Solow, Case Western Reserve University

The meeting agenda also included meetings of The Executive Committee and of ad hoc committees--Committee on Curriculum, Committee on Section Activity, and Committee on Teacher Training and Certification. Breakfast meetings were also held by the MAA Ohio Section campus representatives, and by The Association of Women in Mathematics.

Meeting highlights included discussion sessions and special presentations. *A Panel Discussion: The Computer Science Curriculum* was conducted by Z.A. Karian, Denison University (moderator); L. Benders, Western Electric Corp., Columbus; and L. White, Ohio State University. *A Special Session: Algebraic Graph Theory* was moderated by N. Robertson, Ohio State University. *"Swap" Session* presentations included: *Ways of Attracting High School Students to the Study of Mathematics*, moderated by J.A. Engle, Ohio State University; *Pre-Calculus Mathematics*, moderated by H.L. Putt, University of Akron; and *Video Cassettes for Supplementary Instruction*, Moderated by C.P. Yang, Miami University, Middletown. Also, a special Biographies-of-Great-Mathematicians lecture was presented: *Lewis Carroll*, by R.J. Kolesar, John Carroll University.

The officership and committee chairmanships for academic year 1980-81 include: *Executive Committee*--C.A. Long (Bowling Green State University), Section Chairman; D.O. Koehler (Miami University) Section Past-Chairman; G. Mavrigian (Youngstown State University), Secretary-Treasurer; S.W. Hahn (Wittenberg University), Sectional Governor; D.J. Horwath (John Carroll University), Program Committee Chairman; and J.D. Faires (Youngstown State University). Program Committee--D.J. Horwath, Chairman; A.G. Poorman (Ashland College); and J.P. Leitzel (Ohio State University). *Ad Hoc Committee Chairmen*--Committee on Curriculum: H.L. Putt (University of Akron). Committee on Computing: Z.A. Karian (Denison University). Committee on Section Activity: P.H. Schmidt (University of Akron). Committee on Teacher Training and Certification: W.A. Kirby (Bowling Green State University). Publications Officer and Newsletter Editor: R.A. Little (Baldwin-Wallace College). Representative to the Two-Year College Mathematics Journal: C.P. Yang (Miami University, Middletown). High School Mathematics Competition Supervisor: L.J. Schneider (John Carroll University).

Professor L.J. Schneider was in charge of meeting arrangements for the host institution.

OCTOBER MEETING OF THE INDIANA SECTION

The fall meeting of the Indiana Section of the MAA was held at DePauw University on Saturday, October 18, 1980, with 60 members present. The chairman of the Section, Duane Deal of Ball State University, presided.

The following papers were presented:

- The Geometry of Vision and Visual Illusions*, Wayne M. Zage, Ball State University
How Napier Computed His Table of Logarithms, Meyer Jerison, Purdue University
Can a Mathematician Find Happiness in the Computing Field? William A. Marion, Valparaiso University
Computer Graphics: A Review of the Present State of the Art, Mario Borelli, Notre Dame University
The Hudson-Nash Merger and the Equations of Thermodynamics, Dennis G. Collins, Valparaiso University
Crime by Computer, Michael C. Gemignani, Indiana University-Purdue University at Indianapolis

April Meeting of the Indiana Section

Source: *The American Mathematical Monthly*, Vol. 88, No. 9 (Nov., 1981), p. 724

Published by: Taylor & Francis, Ltd. on behalf of the Mathematical Association of America

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THE MATHEMATICAL ASSOCIATION OF AMERICA
Official Reports and Communications

SPRING MEETING OF THE MARYLAND-DISTRICT OF COLUMBIA-VIRGINIA SECTION

The spring meeting of the Maryland-District of Columbia-Virginia Section of MAA was held on Saturday, April 11, 1981 at the College of William and Mary, Williamsburg, Virginia. Eighty-two registrants attended the meeting. *Marcia Sward*, Associate Executive Director of the MAA, gave the invited address. Her topic was "Death on the Highways: Can Mathematics Help?"

Section Chairman *John Smith* presided at the business meeting. *Ernest Mabrey* (Department of Energy) was elected Vice-Chairman for Membership. Other section officers for the coming year are: Chairman, *John Schmeelk* (Virginia Commonwealth University); Immediate Past Chairman, *John Smith* (George Mason University); Vice-Chairman for Programs, *Patrick Hayes* (Federal Reserve); Treasurer, *Arthur Charlesworth* (University of Richmond); AHSME Exam Coordinator, *Edward Bender* (J. Sargeant Reynolds Community College); Newsletter Editor, *Howard Penn* (U. S. Naval Academy); Governor, *Ronald Davis* (Northern Virginia Community College); and Secretary, *Robert Hanson* (James Madison University). Reports on the Annual High School Mathematics Contest, the national newsletter, summer workshops, and future meetings were given. Hearty thanks were expressed to *John Smith* for his leadership as section chairman for the past several years.

The following talks were presented: "Teaching Technical Mathematics," *Ronald Davis*, Northern Virginia Community College; "Computer Use in the Classroom," *James Newsom*, Tidewater Community College; "Teaching Remedial Mathematics," *Betty Weissbecker*, J. Sargeant Reynolds Community College; "Computer Assisted Instruction," *Edward Huff*, Northern Virginia Community College; "Math Labs in Two Year Colleges: An Informal Discussion," *John Massey*, Tidewater Community College; "Least-Cost Livestock Feeding Using Ethanol Byproducts," *Christopher Reed*, TRW, Inc., and *Douglas Samuelson*, Federal Aviation Administration; "An Algorithm to Route Jets for Transporting Checks Among Federal Reserve Banks," *David McCarthy*, Bureau of Labor Statistics and *Y. C. Park*, Naval Sealift Command; "A Model for Scheduling the Production of Currency," *Hosain Ali Mahan*, The George Washington University; "The Applied Mathematics Laboratory at Towson State University," *John Morrison* and *Martha Siegel*, Towson State University; "Recommendations of the CUPM Subpanel on Computing," *George Engel*, Christopher Newport College; "Recommendations of the CUPM Subpanel on Modeling," *Ralph Disney*, Virginia Polytechnic Institute and State University; "Teaching Computer Graphics," *Caren Diefenderfer*, Hollins College; "A Solution for Rubik's Cube," *Howard Penn*, U.S. Naval Academy; "Group Norms and the Grading of Chronologies," *William Wardlow*, U.S. Naval Academy; "On Sets with Distinct Subset Sums," *Paul Stockmeyer*, College of William and Mary; "Discrete Optimization Using Incremental Analysis," *John Drew* and *Margaret Schaefer*, College of William and Mary; "MAA Placement Testing," *George Lowerre*, Northern Virginia Community College (Woodbridge); "Current and Future MAA Activities: An Informal Discussion," *Marcia Sward*, MAA; "Findings of the MAA Committee on Improving Remediation Efforts in the Colleges," *Eleanor Green Jones*, Norfolk State University; "Production and Use of Video Tapes in Developmental Mathematics," *Calude Moore*, Danville Community College.

APRIL MEETING OF THE INDIANA SECTION

The spring meeting of the Indiana Section of the MAA was held at Indiana University-Purdue University at Indianapolis on Saturday, April 11, 1981, with 59 members present. The Indiana Small College Math Competition was held in conjunction with the meeting.

The following papers were presented at the meeting: "Girard Triangles," *Rodney T. Hood*, Franklin College; "A tiling of the Plane with Triangles," *Paul T. Mielke*, Wabash College; "Counting Matrices of Given Rank," *Ralph P. Grimaldi*, Rose-Hulman Institute of Technology; "Let Us Teach Concepts," *Herman Rubin*, Purdue University; "Differential Games," *Leonard D. Berkovitz*, Purdue University; "Computer Graphics in Teaching Mathematics," *Gerald J. Porter*, University of Pennsylvania; "The Mathematics Curriculum in the 80's," *William A. Marion*, Valparaiso University.

At the business meeting led by Chairman *Duane Deal*, the chairman of the nominating committee *Paul Mielke* presented the following slate of officers for 1981-82, which was unanimously approved: Chairman, *M. Mundt*, Valparaiso University; Vice-Chairman, *C. Cowen*, Purdue University; Secretary-Treasurer, *R. Patterson*, Indiana University-Purdue University at Indianapolis. *Meyer Jerison* of Purdue University was elected Governor. Memberships in the MAA were awarded to *Michael Call*, Rose-Hulman Institute of Technology, and *David Dwyer*, Purdue University, in recognition of their performance on the Putnam examination.

MAY MEETING OF THE ROCKY MOUNTAIN SECTION

The sixty-fourth annual meeting of the Rocky Mountain Section of MAA was held on May 1-2, 1981 on the campus of Colorado College, Colorado Springs, Colorado, with 120 members in attendance. Professor *Leonard Gillman*, Treasurer of the MAA, gave the annual banquet address, "We Can't Teach Our Way Out of a Paper Bag," and the invited address, "Optimal Strategies in Sports."

The program included three panel discussions: "Employment Opportunities for Students," moderated by Professor *John Hodges* of the University of Colorado; speakers were *Robert Frost*, NOAA; Professor *Kent Goodrich*, University of Colorado; Professor *John Sopka*, Ft. Lewis College; and Professor *S.W. Wilson*, University of Colorado. "How Do You Start a Computer Science Program?" moderated by *W.S. Dorn* of Denver University. The speakers included Professor *James Davis* of Mesa College; Professor *Charlotte Murphy*, Metro State College; and Professor *Ron Prather* of Denver University. "How Do We Encourage the Exceptional Student?" moderated by Professor *David Ballew* of South Dakota School of Mines and Technology. The participants were Professor *Stephen Brunn*, University of Southern Colorado and Professor *Paul Perlmutter* of Colorado College.

Twenty-three papers were contributed, eight of them by undergraduate students. "Some Unorthodox Thoughts About Quantum Mechanics," by *Jan Mycielski*, University of Colorado, Boulder; "Can a Mathematician Find Happiness in the Computing Field?" by *William Marion*, Valparaiso University; "Eigenvalues