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The Eighth Annual Meeting of the Indiana Section

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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 $\Sigma c_i z^i = P(z)$ 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

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

Now, if, over a region R of the z-plane, $\text{Lim}_s y_s = y$, then y is a generalized sum (over R) of $P(z)$. For a proper choice of the $\alpha_{i}^{s}, {}_{p}$, 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., $x^nQ_n(\mu)$, $\mu=xz$, 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.