The May Meeting of the Indiana Section and a Conference on Nonlinear Problems

Paul M. Pepper (Secretary)

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. Nastucoff, 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 $dx_i/dt = f_i(x_1, \cdots, x_n)$, $(i = 1, \cdots, n)$ 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

$$(1) \qquad \ddot{x} - k(1 - x^2)\dot{x} + x = bk\lambda \cos(\lambda t + \alpha)$$

represents a physical system in which two stable subharmonics of period $(2n\pm1)2\pi/\lambda$ 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 $(2n\pm1)2\pi/\lambda$. There are also unstable solutions with more complicated behavior near $x=\pm1$.

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

ILLINOIS, Southern Illinois University, Carbondale, May 12–13, 1950.

INDIANA, Wabash College, Crawfordsville, May 6, 1950.

IOWA, State University of Iowa, Iowa City, April 21–22, 1950.

KANSAS, State Teachers College, Pittsburg, April 22, 1950.

KENTUCKY, University of Kentucky, Lexington, April 29, 1950.

LOUISIANA-MISSISSIPPI

MARYLAND-DISTRICT OF COLUMBIA-VIRGINIA, University of Richmond, May 6, 1950.

METROPOLITAN NEW YORK, City College, April 1, 1950.

MICHIGAN

MINNESOTA, Macalester College, St. Paul, May 6, 1950.

MISSOURI

NEBRASKA, Nebraska Wesleyan University, Lincoln, May 6, 1950.

NORTHERN CALIFORNIA, University of San Francisco, January 27, 1951.

OHIO, Denison University, Granville, April 22, 1950.

OKLAHOMA

PACIFIC NORTHWEST, University of Washington, Seattle, June 16, 1950.

PHILADELPHIA, Lehigh University, Bethlehem, Pennsylvania, November 25, 1950.

ROCKY MOUNTAIN, University of Denver, April 28–29, 1950.

SOUTHEASTERN, University of Florida, Gainesville, April 7–8, 1950.

SOUTHERN CALIFORNIA

SOUTHWESTERN, Flagstaff, Arizona, April 29, 1950.

TEXAS, Abilene, April 14–15, 1950.

UPPER NEW YORK STATE, Syracuse University, April 22, 1950.

WISCONSIN, Marquette University, Milwaukee, May 13, 1950.