THE APRIL MEETING OF THE ROCKY MOUNTAIN SECTION

The thirty-sixth annual meeting of the Rocky Mountain Section of the Mathematical Association of America was held at the University of Colorado, Boulder, Colorado, on April 17 and 18, 1953. Professor B. W. Jones, Chairman of the Section, presided at all the sessions.

Of the eighty-five persons who registered, the following fifty-five were members of the Association:

C. F. Barr, D. L. Barrick, B. C. Bellamy, W. E. Briggs, J. R. Britton, R. K. Butz, F. M Carpenter, Sarvadaman Chowla, G. S. Cook, F. W. Donaldson, W. E. Dorgan, F. N. Fisch, C. A. Grimm, Arnold Grudin, H. T. Guard, R. R. Gutzman, Marian S. Gysland, C. L. Harbison, Leota C. Hayward, I. L. Hebel, Ruth I. Hoffman, LeRoy Holubar, P. F. Hultquist, J. A. Hurry, C. A. Hutchinson, B. W. Jones, A. J. Kemper, Claribel Kendall, J. S. Leech, D. C. B. Marsh, Jr., Garner McCrossen, H. C. McKenzie, E. B. McLeod, Jr., W. E. Mientka, W. K. Nelson, Greta Neubauer, D. K. Parks, Lily B. Powell, O. M. Rasmussen, O. H. Rechard, A. W. Recht, L. W. Rutland, Jr., Nathan Schwid, S. R. Smith, W. N. Smith, L. C. Snively, K. H. Stahl, P. O. Steen, E. L. Swanson, C. W. Thomson, E. P. Tovani, E. L. Vanderburgh, V. J. Varineau, W. W. Varner, J. F. Wagner.

At the business meeting, the following officers were elected for the coming year: Chairman, Professor M. L. Madison, Colorado Agricultural and Mechanical College; Vice-Chairman, Professor Nathan Schwid, University of Wyoming; Secretary-Treasurer, Professor F. M. Carpenter, Colorado School of Mines.

The program of papers for the meetings was as follows:

1. *Some results in number theory using a partial summation method*, by Mr. W. E. Briggs, University of Colorado.

In the classical proofs of theorems concerning the representation of primes by binary quadratic forms, it is necessary to use facts about the continuity, differentiability, and behavior as $s \to 1^+$ of the series $\sum (ax^2+2bxy+cy^2)^{-s}$ and other series similar to it. The summation is extended over all x, y which make the form prime to $2D$, where $D=b^2-ac$, and which satisfy certain other conditions if $D>0$. These facts can all be proved simply by estimating the sum as $\sum_{n=1}^{\infty} n^{-s}[T(n)-T(n-1)]$, where $T(n)$ is the number of lattice points within $ax^2+2bxy+cy^2=n$ which make the form prime to $2D$ and satisfy the other conditions if $D>0$.

2. *Polynomials associated with matrices*, by Professor R. K. Butz, Colorado Agricultural and Mechanical College.

Notation was developed to handle the matric equation $AX=XB$, where A and B are specified matrices of order n and m, respectively, defined over an arbitrary field F, and X is to be determined in terms of parameters using only those operations with respect to which F is closed. The approach to the problem was that given by W. V. Parker (*The matrix equation $AX=XB$*, Duke Mathematical Journal, vol. 17, no. 1, 1950, p. 43).

3. *Some topics in the theory of numbers*, Professor Sarvadaman Chowla, University of Colorado.

4. *An approximation method in certain nonlinear boundary value problems*, by Professor Nathan Schwid, University of Wyoming.

In the differential equation of heat conduction,

$$c\rho \frac{\partial u}{\partial t} = \frac{\partial}{\partial x}\left(K\frac{\partial u}{\partial x}\right) + \frac{\partial}{\partial y}\left(K\frac{\partial u}{\partial}\right) + \frac{\partial}{\partial z}\left(K\frac{\partial u}{\partial z}\right),$$

the physical quantities c, the specific heat, and K, the thermal conductivity, are usually considered constant. When these quantities are more realistically regarded as linear functions of the temperature u, the equation is nonlinear. A method of approximation to the solution of the equation, subject to suitable boundary conditions, is here discussed. The method is applicable to situations where the solution for constants c and K is in the form of an infinite series of orthogonal functions each term of which has an exponential factor with negative exponent.

5. *Linear diophantine equations and additive number theory*, by Professor Emeritus A. J. Kempner, University of Colorado. (By invitation.)

We know little about solutions of linear diophantine equations with prescribed restrictions, except for such cases as all solutions positive, or all solutions bounded, *etc.* It is interesting that large groups of problems in the additive number theory can be paraphrased into problems in linear diophantine equations with a certain type of restriction on the solutions. Thus,

$$1x_0 + 3x_1 + 5x_2 + \cdots + (2m + 1)x_m + \cdots = n$$

has a solution $4 \geqq x_0 \geqq x_1 \geqq \cdots \geqq x_m > 0$ for all positive integral n; $28 = 4 \cdot 1 + 4 \cdot 3 + 1 \cdot 5 + 1 \cdot 7$; but has a solution $3 \geqq x_0 \geqq x_1 \geqq \cdots \geqq x_m > 0$ when and only when $n \neq 4^\sigma(8t+7)$. The paraphrase is based on the simple fact: Given a set, finite or infinite, of positive integers $a_0, a_1, \cdots, a_m, \cdots$, with $a_{m+1} > a_m$ (for convenience), and the set $d_0 = a_0$, $d_1 = a_1 - a_0$, $d_2 = a_2 - a_1, \cdots$, then the two statements are equivalent: (a) a given positive integer n is the sum of at most k elements a_m (repetition allowed), and (b) the diophantine equation $d_0x_0 + d_1x_1 + \cdots + d_ma_m + \cdots = n$ has a solution $k \geqq x_0 \geqq x_1 \geqq \cdots \geqq x_m > 0$. Application is made to Pythagorean numbers $(a^2 + b^2 = c^2)$, the formulation of Fermat's theorem $(a^n + b^n = c^n)$, to polygonal and pyramidal numbers, to such equations as $3^x = 2^y + 1$, or $3^x = y^3 + z^3$, *etc.* Emphasis is placed on the Waring-Hilbert theorem on powers, and the Waring-Kamke theorem on polynomials with rational coefficients and integral function values for integral argument values. The Waring-Kamke theorem contains the Waring-Hilbert theorem as a very special case. The paraphrase of the Waring-Kamke theorem may be stated as follows: Let $a_0 = 1, a_1, \cdots, a_m, \cdots$ (positive integers, increasing) be the elements of an arithmetic progression of order k, and let the (positive) first differences $d_0 = a_0$, $d_1 = a_1 - a_0$, $d_2 = a_2 - a_0, \cdots$ also be increasing (for convenience). Then there exists a positive integer $N = N(k; a_0, \cdots, a_k)$, independent of n and of $a_{k+1}, a_{k+2}, \cdots$, such that $d_0x_0 + d_1x_1 + \cdots + d_mx_m + \cdots = n$ has a solution $N \geqq x_0 \geqq x_1 \geqq \cdots \geqq x_m > 0$ (n any positive integer). If $a_0 > 1$, there exists an N as above, and a positive integer $L = L(k; a_0, \cdots, a_k)$ such that in every interval of length L there is at least one positive integer n for which the equation has a solution $N \geqq x_0 \geqq \cdots \geqq x_m > 0$.

The preceding paper was the invited address for the evening session following the customary banquet.

6. *On sets of quasi-conjugate matrices*, by Professor V. J. Varineau, University of Wyoming.

A set of quasi-conjugate matrices is defined by removing the commutativity restriction from the usual definition of conjugate matrices. Thus, a set, $A_1, A_2, \cdots, A_n$, of $n \times n$ matrices over a field $\mathcal{F}$ is quasi-conjugate if the matrices A_i are similar and if $I|xI - A_1| = (xI - A_1)(xI - A_2) \cdots (xI - A_n)$. Elementary properties of such sets are presented and conjectures about general existence theorems are made.

7. *A problem from the* MONTHLY: *Number 4479*, by Professor Emeritus A. J. Kempner, University of Colorado.

Making use of elementary properties of the roots of unity, it is shown that $a_1, a_2, \cdots, a_j, \cdots$ (all $\neq 0$) can be determined so that each $\sum_{j=1}^{\infty} a_j^k$, $k = 1, 2, 3, \cdots$, converges (conditionally) to zero. Each a_j is of the form $\gamma_j \cdot \epsilon_j$, γ_j real, ϵ_j some root of unity.

8. *The content and method for a general mathematics course for adults*, by Miss Ruth I. Hoffman, Byers Junior High School, Denver, Colorado.

9. *The rapid growth of numerical analysis since 1943 and the challenge it offers to the university teacher*, by Mr. W. W. Varner, University of Colorado.

The mushrooming of numerical analysis and its inherent problem of error consideration has greatly increased the need of all teachers of mathematics, engineering, and the sciences to be meticulous in demanding that problem solutions be written in such a manner that the error or uncertainty in every result be clearly and unmistakably given. Certain aspects of this problem were discussed.

10. *On the improvement of service courses in freshman mathematics*, by Professor I. L. Hebel, Colorado School of Mines.

An outline is presented of a revised approach to the teaching of freshman mathematics adopted at Colorado School of Mines. The traditional sequence of topics is replaced by a unification that stresses the analytic geometry viewpoint throughout and that maintains the necessary rigor of a pre-engineering mathematics course. Principal results of the initial trial of the plan include increased student interest, improved faculty instruction, and a better prepared student for sophomore courses. The author and his staff feel that such a curriculum is a forward step in the solution of the perplexing freshman teaching problem.

11. *Mathematics used in university departments other than mathematics or engineering*, by Professor O. M. Rasmussen, University of Denver.

A report was presented on a part of a study using the methods of textbook analysis, interviews, and questionnaires to determine those mathematical skills and concepts that are desirable as preparation for non-mathematics course work for university students not majoring in mathematics or the physical sciences. The mathematics needed for a vast majority of these students is quite elementary and many of the students do not possess sufficient arithmetical maturity to enable them to gain maximum benefit from a large number of university courses. An understanding of elementary statistics is needed in many courses throughout the university.

J. R. BRITTON, *Secretary*

THE APRIL MEETING OF THE TEXAS SECTION

The annual meeting of the Texas Section of the Mathematical Association of America was held at Texas Christian University, Fort Worth, Texas, on April 24-25, 1953. Professor C. B. Wright, Chairman of the Section, presided at the sessions. Professor L. R. Ford, who was an invited guest, contributed much to the success of the meeting.

There were one hundred eight persons in attendance, including the following sixty-two members of the Association:

T. A. Abouhalkah, R. C. Ailara, A. W. Ashburn, A. V. Banes, Ina M. Bramblett, H. E. Bray, Myrtle C. Brown, M. L. Coffman, L. A. Colquitt, J. V. Cooke, Don Cude, F. W. Donaldson, G. H. Dubay, L. K. Durst, Terrell Ellis, L. R. Ford, Gordon Fuller, R. L. Glass, Blanche B. Grover, W. T. Guy, Jr., E. H. Hanson, E. A. Hazelwood, E. R. Heineman, Fay H. Johnson, Ruth Kissel, E. C. Klipple, H. A. Luther, Hazel L. Mason, Lida B. May, Dorothy McCoy, W. K. McNabb, V. A. Miculka, Harlan C. Miller, B. C. Moore, E. D. Mouzon, Jr., C. A. Murray, Albert Newhouse, Bob Parker, H. C. Parrish, C. J. Pipes, C. B. Rader, Sr., L. W. Ramsey, Dorothy L. Rees, C. L. Riggs, Virginia E. Roberts, C. A. Rogers, R. Q. Seale, C. R. Sherer, D. P. Shore, Sister Mary of Perpetual Help, D. W. Starr, W. G. Stokes, W. W. Taylor, Earl Thomas, F. E. Ulrich, R. S.