May Meeting of the Indiana Section

J. C. Polley (Secretary)

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 $P(x)=\sum_{i=0}^{n}a_ix^{n-i}$, 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 $0<x\leqq d$ and $-d\leqq x<0$, $|p(x)|=\sum_{i=0}^{n-1}a_ix^{n-i}<D$, 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 $i, j=1, \cdots, n$, 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 $b_i=\sum_j y_{ji}-\sum_j y_{ij}$ and $b_i=\sum_j x_{ij}-\sum_j x_{ji}$ where $x_{ij}\geqq 0$ (thus defining a convex polyhedral set). Hence $Z=\sum_{ij}t_{ij}y_{ij}+\sum_{ij}s_{ij}x_{ij}=Y+X$, 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 $p_{ij}-p_i+p_j-t_{ij}\leqq 0$ and $-p_i+p_j-s_{ij}\leqq 0$ for all (i, j), the former being zero for $y_{ij}>0$, 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*