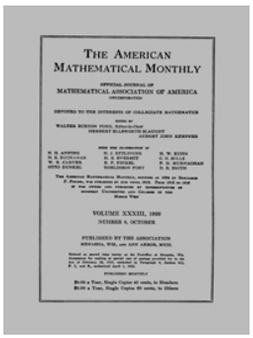

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H. T. Davis (Secretary-Treasurer)

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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 $\theta=x\ d/dx$, 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.