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THE ELEVENTH MEETING OF THE INDIANA SECTION

The eleventh meeting of the Indiana Section of the Mathematical Association of America was held on Friday and Saturday, May 11–12, 1934, at Purdue University, Lafayette, Indiana.

There were forty-one registered for the meetings on Saturday including the following twenty-seven members of the Association: Stanley Bolks, J. H. Butchart, H. T. Davis, C. S. Doan, J. E. Dotterer, W. E. Edington, C. H. Frick, E. D. Grant, G. H. Graves, W. R. Hardman, C. T. Hazard, F. H. Hodge, H. K. Hughes, E. L. Klinger, Juna M. Lutz, William Marshall, T. E. Mason, Gertrude I. McCain, Gladys (Banes) McColgin, H. A. Meyer, G. T. Miller, J. A. Reising, C. K. Robbins, L. S. Shively, R. B. Stone, Anna K. Suter, K. P. Williams.

On Friday evening a joint dinner meeting was held with the Purdue chapter of Sigma XI and the Indiana Association of College Physics Teachers. Following the dinner there was a public address by Professor R. D. Carmichael of the University of Illinois on the subject "Consonance of thought and things." Professor Carmichael's paper contains a contribution to a problem in the philosophy of science, namely, the problem of the extent of agreement which exists between the relations connecting phenomena in experience on the one hand, and on the other the relations connecting the elements of thought when presented in deductive form.

The sessions on Saturday were presided over by the retiring chairman, Professor Juna M. Lutz. At the business session the following officers were elected: Chairman, Professor T. E. Mason, Purdue University; Vice-Chairman, Professor H. A. Meyer, Hanover College; Secretary, Professor P. D. Edwards, Ball State Teachers College.

At the afternoon session a resolution was passed expressing the sorrow of the members because of the death of Professor E. N. Johnson of Butler University. Professor Johnson was one of the charter members of the Indiana Section and served as the Chairman in 1927. A second resolution expressed the appreciation of the members of the Section of the courtesy extended them by the members of the staff of Purdue University and to Professor Carmichael and to Professor Roys for their addresses.

The following papers were presented at the Saturday sessions.

1. "The need for mathematical training in the biological and social sciences" by the retiring chairman, Professor Juna M. Lutz, Butler University.

2. "An engineer looks at mathematics" by Professor Carl S. Roys, Department of Electrical Engineering, Purdue University, by invitation of the Program Committee.

3. "The bearing of college mathematics on the teaching of secondary mathematics" by Professor K. P. Williams, Indiana University.

4. "A vacation among mathematicians" by Professor T. E. Mason, Purdue University.

5. "An experiment with student criticism" by Professor G. H. Graves, Purdue University.

6. "Properties of the polygamma function" by Professor H. T. Davis, Indiana University.

7. "On the asymptotic development of analytic functions" by F. C. Smith, Fort Wayne, by invitation.

8. "Helices in Euclidean n-space" by Dr. J. H. Butchart, Butler University.

9. "Ghost waves and negative energy" by A. W. Pershing, Indiana University, by invitation.

Abstracts of the papers follow, the numbers corresponding to the numbers of the papers:

1. In the opinion of the mathematician, there are valuable applications of his theory in all fields. To what extent do others share his view? In particular, many examples in the biological and social sciences can be found where quantitative methods indicate underlying laws which were uncertain or obscure when the qualitative method of description only was used. Some specialists in these fields are convinced that mathematical training is desirable or even essential, but they seem to be in the minority. The result of a questionnaire which was sent to the heads of the departments of biology and social science in a number of the larger universities indicates that there is still no general need felt for such training. Few schools require any collegiate mathematics of their majors in these subjects, and graduate students are usually advised to take such courses only when their thesis work requires it. Some have advocated special mathematical courses in preparation for work in these sciences. Which topics should be included in these courses, which ones omitted, and whether these brief courses would be sufficient to supplant the conventional ones are open questions. The responsibility of proving the practical value of his subject rests partly upon the college teacher of mathematics. It is his duty to discover as many of the applications of his theory as possible and to show his students and associates in other fields that it is a necessary and vital factor in the advancement of all scientific knowledge.

2. By way of introduction, Professor Roys brought out the fact that the theory of Electrical Engineering has always been characterized by the gradual reduction of the older phases of the subject to an exact science, together with a rapid expansion in the field of application. This has resulted in a larger proportion of the electrical engineers requiring a training today that is at once more extensive and analytical than has been required in the past. The part played by the mathematician in training the engineer, together with his development of new operations many years in advance of possible applications to material problems was discussed.

Mathematics was treated as a "tool," "a system of shorthand notation," and as a research method following the lines of either inductive or deductive

reasoning. Many illustrations from engineering practice and teaching experience were cited that show the advantages of the analytical method as well as the possibilities of arriving at erroneous results if the work is too completely divorced from practical considerations. The ability to consider on paper the effect of varying a single factor at a time, in contrast to the futility, in many cases, of even attempting such a procedure in the laboratory, was especially emphasized.

In conclusion, a number of research topics were suggested whose solutions would require not simply a close cooperation between an engineer and a mathematician, but rather the combined efforts of an engineer-mathematician and a mathematician-engineer. This led to an advancement of the idea that a major line of study should be offered in engineering schools that would be known as Mathematical Engineering, corresponding to the present Mathematical Physics in schools of science.

3. The importance of an active interest on the part of the mathematicians of the state in the mathematics of the secondary schools was discussed and a committee is to be appointed to formulate plans for the Indiana Section of the Association to take the initiative in stimulating greater interest in mathematics.

4. Professor Mason related some incidents of his stay at Cambridge University and his attendance at the International Congress of Mathematicians at Zurich.

5. For the past nine years, Professor Graves has made a practice of asking students to criticize, under conditions insuring anonymity, the course they have had. This is in the belief that teachers need to know what students are thinking about their courses and to impress upon students the fact that their relation to their own education is much broader than merely following a prescribed series of lessons.

Since the experiment started, Professor Graves' method of administering cources has been extensively modified.

6. In this paper the author discussed the properties of the polygamma functions, namely the nth derivatives of $\psi(x) = d \log \Gamma(x)/dx$. Special attention was paid to the asymptotic expansion of the zeros of these functions on the negative real axis. The theorem of Gauss for the computation of values of $\psi(x)$ at rational points in the interval (0,1) was extended to the polygamma functions. Announcement was made that the statistics laboratory of Indiana University has completed tables of the trigamma, tetragamma, pentagamma, and hexagamma functions from $x = -10$ to $x = 100$ at intervals from .01 to .1 to 10 and 15 significant figures, eight thousand values in all. This computation required auxiliary tables from 16 to 18 significant figures of $1/x^n$, $n = 2, 3, 4, 5$, for the first thousand integers. Work on the pentagamma and hexagamma tables was largely carried out by E. B. Morris and Lucy C. Kantz.

7. During the years 1900–1908, E. W. Barnes obtained the asymptotic developments of a large number of function types by means of highly specialized

methods. In more recent years, general methods of determining such asymptotic expansions have been developed by W. B. Ford and C. V. Newsom. In this paper F. C. Smith used the general theory in considering the asymptotic behavior of the following function types:

(1) $f(z) = \sum_{n=0}^{\infty} \frac{z^n}{(n+\theta)^\beta}$; (2) $f(z) = \sum_{n=0}^{\infty} \frac{h(n)z^n}{\Gamma(n+P)}$.

8. A necessary and sufficient condition for a curve in three dimensions to be a helix is that the ratio of the first and second curvatures be constant. This condition is generalized for a curve in n-space and the author then takes up some properties of helices and associated curves termed pseudo-helices.

9. Mr. Pershing discussed the mathematical theory and physical interpretation of deBroglie waves. He showed the connection between Fermat's principle in the classical optics and the principle of least action. He indicated that the maximum velocity c in free space as postulated in relativity is true only for the motion of real energy packets. A simple derivation of the Bohr atom from the deBroglie equation was given and the relativistic formulation of the Schrödinger hydrogen atom was converted to the Bohr form by a simple reduction to the equation of matter waves. His correlation of the orbital frequency of an electron, material wave frequency, and radiated frequency was described. The speaker discussed the quantization of the space time continuum and made application of the Fermi Dirac statistics to negative energy states. Holes in space were interpreted as real entities with apparent masses, and the extension made of ghost waves to virtual and negative masses.

P. D. EDWARDS, *Secretary*

THE ANNUAL MEETING OF THE MINNESOTA SECTION

The annual meeting of the Minnesota Section of the Mathematical Association of America was held at St. Olaf College, Northfield, Minnesota, on Saturday, May 12, 1934. Sessions were held at 11:00 o'clock and at 2:15 o'clock with a luncheon at 12:45 o'clock.

Professor C. S. Carlson, chairman of the Section, presided at the two sessions, except when Professor R. W. Brink relieved the chairman during the presentation of his own paper. Seventy-five persons attended the meeting including the following thirty members of the Association: Sister Mary Aloysius, C. J. Blackall, Jessie W. Boyce, R. W. Brink, L. E. Bush, W. H. Bussey, C. S. Carlson, L. L. Cruise, H. H. Dalaker, Margaret C. Eide, C. H. Fischer, Gladys Gibbens, C. H. Gingrich, Borghild Gunstad, W. L. Hart, H. E. Hartig, E. Marie Hove, Dunham Jackson, C. M. Jensen, W. H. Kirchner, Marie M. Ness, M. G. Scherberg, A. J. Strane, F. J. Taylor, Ella Thorp, A. L. Underhill, O. E. Walder, Marion B. White, Marian A. Wilder, G. L. Winkelmann; and Sister Thomas à Kempis, institutional member representative.

At the afternoon session a vote of thanks was adopted as a sign of appreciation of the cordial hospitality of St. Olaf College, and the efforts of its depart-