

tion in a remarkable manner, the result being that no essentially new functions could be defined by differential equations of the first order with fixed singular points. Painlevé has since then found that transcendental functions essentially new can be defined by such equations of order higher than the first.

We will close this brief sketch by translating a sentence, which is as characteristic of the modern theory of differential equations, as the famous definition of Kirchhoff is of modern mechanics. Fuchs says in his famous paper in *Crelle's Journal*: "In the present condition of science it is not so much the problem of the theory of differential equations to reduce a given differential equation to quadratures, as to deduce from the equation itself the behavior of its integrals at all points of the plane, *i. e.*, for all values of the complex variable."

This is the present point of view in the theory of differential equations. The first chapter of this theory, that of linear differential equations, has been far advanced, although not completed, by Fuchs and his pupils. Something has been done on later chapters, but not much. The theory of non-linear differential equations is one of the central problems of modern mathematics, but it has not yet found its Fuchs.

E. J. WILCZYNSKI.

UNIVERSITY OF CALIFORNIA,  
BERKELEY, July 8, 1902.

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#### NOTES.

THE fifty-first annual meeting of the American association for the advancement of science, was held at Pittsburgh, June 28–July 3. The total number of members in attendance was 431, and 320 papers and addresses were presented, of which 24 are classified under mathematics and astronomy (Section A). Among the officers elected for the coming year are: President of the Association, Dr. IRA REMSEN; Vice-president of Section A, Professor G. B. HALSTED; Secretary of Section A, Professor C. S. HOWE. A report of the meeting of Section A will appear in an early number of the BULLETIN. It was decided to hold the next meeting of the Association at Washington, D. C., in convocation week, December 29, 1902 – January 3, 1903.

IN its annual list of doctorates conferred by American universities during the academic year closing with June, 1902, *Science*

records the following with theses in mathematics: A. B. COBLE, Johns Hopkins University, "A study of the ternary quartic in its relation to the conics"; OTTO DUNKEL, Harvard University, "Regular singular points of a system of homogeneous linear differential equations of the first order"; PETER FIELD, Cornell University, "The forms of unicursal quintic curves"; CARL GUNDERSEN, Columbia University, "On the measure or content of assemblages of points"; C. J. KEYSER, Columbia University, "The plane geometry of the point in space of four dimensions"; T. M. PUTNAM, University of Chicago, "Concerning the linear fractional group on three variables with coefficients in the Galois field of order  $p^n$ "; H. L. RIETZ, Cornell University, "On primitive groups of odd order"; W. E. TAYLOR, Syracuse University, "On the product of an alternant by a symmetric function."

OXFORD UNIVERSITY. — The following courses in mathematics are announced for Michaelmas term, 1902: — By Professor E. B. ELLIOT: Theory of numbers, two hours; Theory of functions, one hour. — By Professor H. H. TURNER: Elementary mathematical astronomy, two hours. — By Professor W. ESSON: Analytic geometry of plane curves, two hours; Synthetic geometry of plane curves, one hour. — By Professor A. E. H. LOVE: Spherical harmonics and other methods of analysis that are appropriate in applications to physics, three hours. — By Mr. C. E. HASELFOOT: Algebra, two hours. — By Mr. C. LEUDES-DORF: Projective geometry, three hours. — By Mr. A. E. JOLLIFFE: Analytical geometry, two hours. — By Mr. J. W. RUSSELL: Differential calculus, two hours. — By Mr. R. F. MCNEILE: Curve tracing, one hour. — By Mr. P. J. KIRKBY: Introduction to higher algebra, one hour. — By Mr. A. L. PEDDER: Problems in pure mathematics, one hour. — By Mr. C. H. SAMPSON: Solid geometry, two hours. — By Mr. J. E. CAMPBELL: Differential equations, two hours. — By Mr. C. H. THOMPSON: Integral calculus, two hours. — By Mr. E. H. HAYES: Analytical statics, three hours. — By Mr. A. L. DIXON: Hydrostatics, one hour. — By Mr. H. T. GERRANS: Advanced rigid dynamics, two hours.

Considerable changes will be made in the First Public Examination for those who seek honors in mathematics by a scheme which comes into effect in 1904. A new subject, viz:

The elements of analytical geometry of three dimensions, is to be introduced ; and restrictions on the freedom of choice of methods are to be removed. Under the existing scheme the elements of the mechanics of solids and fluids is treated without the aid of the infinitesimal calculus ; in future the use of the calculus in its applications to mechanics is to be encouraged. At present there is a separation of geometry into two papers, devoted respectively to analytical and synthetic methods ; in future candidates are to be encouraged to choose the method, analytical or synthetic, which appears the more appropriate in answering any question. The examination is taken in the first year or the second year of the academic course, and successful candidates have the option of proceeding to a final honors school in mathematics, or in physics, or in any other subject ; in these respects the new scheme makes no changes.

THE several German universities below offer during the winter semester, 1902-1903, courses in mathematics as follows :

UNIVERSITY OF BERLIN. — By Professor H. A. SCHWARZ : Differential calculus, four hours, with exercises, two hours ; Maxima and minima in elementary geometrical treatment, two hours ; Applications of the theory of elliptic functions, four hours ; Colloquium, two hours ; Seminar, three hours. — By Professor G. FROBENIUS : Theory of determinants, four hours ; Algebra, four hours ; Seminar, three hours. — By Professor R. LEHMANN-FILHÉS : Analytical geometry, four hours ; Theory of probabilities, one hour. — By Professor J. KNOBLAUCH : Theory of space curves and curved surfaces, four hours ; Analytical mechanics, four hours ; Proseminar, one hour. — By Professor K. HENSEL : Integral calculus, four hours, with exercises, two hours ; Theory of elliptic functions, four hours. — Professor G. HETTNER : Theory of definite integrals, two hours. — By Dr. E. LANDAU : Theory of numbers, four hours ; Theory of linear differential equations, four hours ; Mengenlehre, one hour.

UNIVERSITY OF BONN. — By Professor L. HEFFTER : Analytical mechanics, four hours ; Plane analytical geometry, four hours, with exercises, one hour. — By Professor H. KORTUM : Elliptic functions, four hours ; Seminar, two hours. — By Professor R. LIPSCHITZ : Integral calculus II, four hours ; Seminar, two hours. — By Professor J. SOMMER : Algebra, two hours ; Geometrical applications of the theory of functions,

two hours. — By Dr. WENTSCHER: Philosophy of mathematics, one hour.

UNIVERSITY OF Breslau. — By Professor J. ROSANES: Differential calculus and elements of integral calculus, four hours; Theory of invariants, two hours; Seminar, one hour. — By Professor R. STURM: History of mathematics, one hour; Seminar, two hours; Theory of numbers, three hours; Geometrical loci of higher degree, three hours. — By Professor F. LONDON: Introduction to the theory of differential equations, three hours; Mathematics of insurance, two hours.

UNIVERSITY OF Erlangen. — By Professor P. GORDAN: Analytical geometry, four hours; Invariants, four hours; Seminar, three hours. — By Professor M. NÖTHER: Infinitesimal calculus, four hours; Theory of functions, four hours. — Seminar.

UNIVERSITY OF Freiburg. — By Professor J. LÜROTH: Analytical mechanics, four hours; Least squares, two hours; Seminar. — By Professor L. STICKELBERGER: Plane analytical geometry and differential calculus, five hours, with exercises, two hours. — Theory of analytic functions, three hours. — By Professor A. LOEWY: Theory of curves and surfaces, four hours; Mathematics of insurance, two hours. — By Dr. E. REBMAN: History of arithmetic, two hours.

UNIVERSITY OF Göttingen. — By Professor F. KLEIN: Encyclopædia of mathematics, four hours; Seminar (with Professor Bohlmann), two hours. — By Professor D. HILBERT: Differential and integral calculus II, four hours; Mechanics of continua, four hours; Seminar in the theory of functions, two hours. — By Professor K. SCHWARZSCHILD: Celestial mechanics, three hours, with exercises, two hours. — By Professor H. MINKOWSKI: Algebra, three hours; Analysis situs, two hours; Seminar in the theory of functions, two hours. — By Professor M. BRENDel: Introduction to theoretical astronomy, three hours; Life and work of Gauss, one hour. — By Professor F. SCHILLING: Analytical theory of curved lines and surfaces, four hours, with exercises, two hours. — By Professor G. BOHLMANN: Theory of probabilities, two hours; Theory of risks, two hours; Seminar, two hours; Seminar in the mathematics of insurance, two hours. — By Dr. E. ZERMELO: Theory of functions, four hours; Exercises in integral calculus and potential theory, two hours. — By Dr. BLUMENTHAL: Abelian func-

tions, two hours; Introduction to higher mathematics for students of science, with exercises, three hours.

UNIVERSITY OF HEIDELBERG. — By Professor L. KOENIGSBERGER: Higher algebra, theory of algebraic equations, four hours; Elements of the theory of differential equations, two hours; Calculus of variations, one hour; Theory of numbers, one hour; Seminar, two hours. — By Professor H. VALENTINER: Theory of orbits, three hours. — By Professor M. CANTOR: Differential and integral calculus, four hours, with exercises, one hour; Political arithmetic, two hours. — By Professor F. EISENLOHR: Theoretical optics, four hours; Differential and integral calculus, five hours; Potential, two hours. — By Professor K. KOEHLER: Synthetic geometry of space, three hours. — By Professor G. LANDSBERG: Descriptive geometry, with exercises, four hours; Theory of functions, three hours. — By Dr. K. BOEHM: Theory of partial differential equations, one hour; Vector analysis, one hour; D'Alembert's memoir on dynamics, one hour.

UNIVERSITY OF JENA. — By Professor J. THOMAE: Application of infinitesimal calculus to geometry, four hours; Definite integrals and Fourier series, four hours; Seminar, two hours. — By Professor A. GUTZMER: Analytical geometry of space, four hours; Analytical mechanics, four hours, with seminar, one hour. — By Professor J. FREGE: Differential and integral calculus II, with exercises, five hours.

UNIVERSITY OF KIEL. — By Professor L. POCHHAMMER: Elements of the theory of numbers, three hours; Introduction to the theory of functions, three hours; Seminar one hour. — By Professor P. HARZER: Celestial mechanics, three hours. — By Professor P. STÄCKEL: Integral calculus, three hours; Differential geometry of curved surfaces, three hours; Intrinsic geometry of curves, one hour; Seminar, one hour.

UNIVERSITY OF LEIPSIK. — Professor SCHEIBNER offers no lectures during the winter semester. — By Professor C. NEUMANN: Differential and integral calculus, four hours; Seminar, two hours. — By Professor H. BRUNS: Theory of probabilities, four hours; Celestial mechanics, two hours. — By Professor A. MAYER: Calculus of variations, four hours. — By Professor O. HÖLDER: Elliptic functions, four hours; Partial differential equations, two hours; Seminar, one hour. — By Professor F.

ENGEL: Determinants and algebraic equations, four hours; Theory of transformation groups (continuation), two hours; Seminar, two hours. — By Dr. F. HAUSDORFF: Analytical mechanics, three hours, with exercises, one hour. — By Dr. H. LIEBMANN: Analytical geometry of space, two hours; Theory of definite integrals, two hours; Descriptive geometry, two hours, with exercises, one hour.

UNIVERSITY OF STRASSBURG. — By Professor T. REYE: Geometry of position, three hours; Analytical mechanics, two hours; Seminar, two hours. — By Professor H. WEBER: Partial differential equations of mathematical physics, four hours; Selected chapters of algebra, two hours; Seminar, two hours. By Professor F. ROTH: Algebraic analysis and determinants, three hours; Analytical geometry of space, two hours; Ordinary differential equations, two hours. — By Professor A. KRAZER: Infinitesimal calculus, four hours; Analytical geometry of the plane, three hours; Seminar, two hours.

THE London mathematical society awarded its De Morgan medal for 1902 to Professor A. G. GREENHILL.

PROFESSORS ORMOND STONE, of the University of Virginia, E. H. MOORE, of the University of Chicago, and FRANK MORLEY, of Johns Hopkins University, have been appointed by the executive committee of the Carnegie Institution, as advisors in relation to original research in mathematics.

PROFESSOR W. E. STORY, while retaining his chair in Clark University, has been appointed head of the mathematical department in the newly established Clark College, Worcester, Mass. Mr. F. H. HODGE, at present fellow in mathematics in Clark University, becomes instructor in mathematics in the college.

AT the University of Nebraska, Dr. R. E. MORITZ, who recently returned from a year's study abroad, has been appointed to an adjunct professorship of mathematics.

DR. CHARLES W. M. BLACK, instructor in mathematics in the University of Oregon, died August 11, at La Grande, Ore.