

The second part of the memoir is devoted to the determination of the group of rationality of a differential equation with rational (or algebraic) coefficients. A new classification of homogeneous linear groups enables the author to refer the determination of the group of rationality to the resolution of the problem of determining whether a linear differential equation with rational coefficients admits of an integral whose logarithmic derivative is rational or algebraic; hence the conclusion that we can always determine the group of rationality of a linear equation of order two, three or four, or refer the determination to the study of an abelian integral. The author thus finds all the possible cases of reduction of a linear equation of the fourth order. He refers the integration problem to its canonic form. The method used extends itself immediately to equations of higher order.

In the concluding chapter the work of von Koch\* is applied to the study of the question of finding whether a linear equation with rational coefficients admits of an integral whose logarithmic derivative is meromorphic (normal integral), to which problem Marotte refers the determination of the group of monodromism attached to a singular point of a linear equation.

M. Marotte's second thesis was on the general principles of dynamics.

5. The remarkable thesis of Drach calls for more extended notice than can be given to it in the space at command for this article. A suitable review of the memoir will appear in a subsequent number of the BULLETIN.

E. O. LOVETT.

PRINCETON UNIVERSITY.

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#### NOTES.

At the annual meeting of the Society, December 28, 1899, President R. S. WOODWARD will deliver a presidential address on "The century's progress in applied mathematics."

THE president (Lord KELVIN), the vice-presidents and the secretaries of the London mathematical society have been renominated to serve in the same capacity on the council for the ensuing year. Professor W. BURNSIDE,

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\* *Acta Math.*, vol. 18; *Comptes rendus*, 1893.

Mr. H. M. MACDONALD and Mr. E. T. WHITTAKER, have been nominated to fill the vacancies on the council. At the annual meeting which was held on November 9th, the DeMorgan medal was presented to the sixth medalist, Professor BURNSIDE. The Council have sanctioned the issue by the secretaries of an index to the first thirty volumes of the *Proceedings*, which will be drawn up on the same lines as that of the first fifty volumes of the *Mathematische Annalen*. They have also authorized Mr. R. TUCKER to draw up a list of all the members elected since the foundation of the society in 1865.

THE American physical society held its first regular meeting at Columbia University, October 28th. It is proposed to hold four meetings annually, simultaneously with the AMERICAN MATHEMATICAL SOCIETY. The present officers are Professors H. A. ROWLAND, president; A. A. MICHELSON, vice-president; E. MERRITT, secretary; W. HALLOCK, treasurer.

THE recently organized Astronomical and astrophysical society of America has elected the following officers: president, Professor SIMON NEWCOMB, of Johns Hopkins University; first vice-president, Professor CHARLES A. YOUNG, of Princeton University; second vice-president, Professor GEORGE E. HALE, of Yerkes Observatory; secretary, Professor GEORGE C. COMSTOCK, of Washburn Observatory; treasurer, Professor C. L. DOOLITTLE, of the University of Pennsylvania.

The Festschrift prepared in honor of the seventieth birthday, August 23, 1899, of Professor MORITZ CANTOR, of Heidelberg, the well-known historian of mathematical science, has just appeared as a supplement to the forty-fourth volume of the *Zeitschrift für Mathematik und Physik*, from the press of Teubner, under the editorship of Professors M. CURTZE, of Thorn, and S. GÜNTHER, of Munich. The volume of more than six hundred pages contains a heliogravure portrait of Professor Cantor, a catalogue of his scientific work, and the following thirty-two memoirs devoted to historical subjects:

“Développement des procédés servants à décomposer le quotient en quantités,” by V. V. BOBYNEN, of Moscow; “Zur Geschichte der prosthaphaeretischen Methode in der Trigonometrie,” by A. v. BRAUNMÜHL, of Munich; “Notes on the history of logarithms,” by FLORIAN CAJORI, of Colorado Springs; “Der Tractatus Quadrantis des Robertus

Anglicus in deutscher Uebersetzung aus dem Jahre 1477," by M. CURTZE, of Thorn; "Zur Geschichte der Prinzipien der Infinitesimalrechnung. Die Kritiker der 'Théorie des fonctions analytiques' von Lagrange," by S. DICKSTEIN, of Warsaw; "P. W. Wargentin und die sogenannte Halley'sche Methode. Ein Beitrag zur Geschichte der mathematischen Statistik," by G. ENESTRÖM, of Stockholm; "Intorno ad un inedito e sconosciuto Trattato di Meccaniche di Galileo-Galilei nell'Archivo di S. A. il Principe di Thurn-Taxis in Ratisbona," by A. FAVARO, of Padua; "Zur Geschichte der Längenbestimmung zur See," by E. GELCICH, of Triest; "Die Geometrie von Le Clerc und Ozanam, ein interessantes mathematisches Plagiat aus dem Ende des XVII. Jahrhunderts," by J. H. GRAF, of Bern; "Nikolaus von Cusa und seine Beziehungen zur mathematischen und physikalischen Geographie," by S. GÜNTHER, of Munich; "On an allusion in Aristotle to a construction for parallels," by T. S. HEATH, of Cambridge, England; "Byzantinische Analekten," by J. L. HEIBERG, of Copenhagen; "Ueber die Aufgaben einer Geschichte der Physik," by A. HELLER, of Budapest; "Winkelmessungen durch die Hipparchische Dioptra," by F. HULTSCH, of Dresden; "Des Rheticus Canon doctrinæ triangulorum und Vieta's Canon mathematicus," by K. HUNRATH, of Rendsburg; "Il 'Giornale de Letterati d'Italia' di Venezia e la 'Raccolta Calogerà' come fonti per la storia delle matematiche nel secolo XVIII.," by G. LORIA, of Genoa; "Notes sur le caractère géométrique de l'ancienne astronomie," by P. MANSION, of Gand; "Ueber die Encyclopädie der mathematischen Wissenschaften," by W. F. MEYER, of Königsberg; "Zur Terminologie der ältesten mathematischen Schriften in deutscher Sprache," by F. MÜLLER, of Loschwitz; "Die Rechenmethoden auf dem griechischen Abakus," by A. NAGL, of Vienna; "Die Geschichte der exakten Wissenschaften und der Nutzen ihres Studiums," by F. ROSENBERGER, of Frankfort; "Die Unverzagt'schen Liniencoordinaten. Ein Beitrag zur Geschichte der analytischen Geometrie," by F. RUDIO, of Zurich; "Franz Adolph Taurinus. Ein Beitrag zur Vorgeschichte der nichteuclidischen Geometrie," by PAUL STÄCKEL, of Kiel; Johann Scheubel, ein deutscher Algebraiker des XVI. Jahrhunderts, by H. STAIGMÜLLER, of Stuttgart; "Mathematik bei den Juden (1501-1550)," by M. STEINSCHNEIDER, of Berlin; "Bemerkungen zur Geschichte der altgriechischen Mathematik," by A. STURM, of Seitenstetten; "Der Oculus Archimedi oder das Syntemachion des Arch-

imedes. Zum ersten Male nach zwei Manuscripten der Kgl. Bibliothek zu Berlin herausgegeben und übersetzt," by H. SUTER, of Zurich; "Les 'Excerpta ex M. SS. R. Des-Cartes,'" by PAUL TANNERY, of Pantin; "Einige Additionsmaschinen," by F. A. UNGER, of Leipzig; "Zur Geschichte der deutschen Algebra," by E. WAPPLER, of Zwickau; "Pierre Fermat's Streit mit John Wallis. Ein Beitrag zur Geschichte der Zahlentheorie," by G. WERTHEIM, of Frankfort; "Die Entdeckung der Parabelform der Wurflinie," by E. WOHLWILL, of Hamburg.

THE following recently issued catalogues of new and second hand scientific publications are more or less rich in mathematical works:—catalogue 40, Karl Krebs, Giessen, Germany; catalogue 276, Macmillan and Bowes, Cambridge, England; catalogue 173, Mayer and Müller, Berlin, Germany; catalogue 92, Oswald Weigel, Leipsic, Germany. M. A. Hermann, of Paris, will issue a new catalogue this month (November).

OXFORD UNIVERSITY. The courses of lectures announced for the fall term of 1899 include the following on mathematical subjects:—By Professor W. ESSON: Analytic theory of place curves; Synthetic theory of place curves.—By Professor H. TURNER: Mathematical astronomy.—By Professor A. E. H. LOVE: Electricity and magnetism.—By Professor E. ELLIOTT: Theory of numbers.

CAMBRIDGE UNIVERSITY. Mathematical courses are announced as follows for the current academic year: *Michaelmas term*, 1899:—By Professor G. G. STOKES: Hydrodynamics, three hours.—By Professor A. R. FORSYTH: Theory of differential equations, three hours; Calculus of variations, two hours.—By Professor G. H. DARWIN: Lunar theory, three hours.—By Mr. R. PENDLEBURY: Theory of equations, three hours; Spherical astronomy, three hours.—By Dr. E. W. HOBSON: Spherical and cylindrical harmonics, three hours.—By Mr. J. LARMOR: Electricity and magnetism, three hours.—By Mr. H. F. BAKER: Theory of functions, three hours.—By Mr. H. M. MACDONALD: Waves (especially waves of light), three hours.—By Mr. H. W. RICHMOND: Plane analytical geometry, three hours.—By Mr. G. T. WALKER: The electromagnetic field, three hours.—By Mr. E. T. WHITTAKER: The problem of three bodies, three hours.—By Mr. J. H. GRACE: Invariants and geometrical applications, three hours.—*Lent term*, 1900:—By Professor G. G. STOKES: Physical optics.

—By Professor A. R. FORSYTH : The differential equations of theoretical dynamics.—By Professor R. S. BALL : Planetary theory.—By Mr. R. PENDLEBURY : Theory of numbers.—By Dr. E. W. HOBSON : Vibrations and sound.—By Mr. J. LARMOR : Electricity and magnetism (continuation).—By Mr. H. F. BAKER : Theory of functions (continuation).—By Mr. H. M. MACDONALD : Elasticity.—By Dr. J. W. L. GLAISHER : Elliptic functions.—By Mr. R. A. HERMAN : Hydrodynamics.—By Mr. A. N. WHITEHEAD : Universal algebra.—By Mr. A. BERRY : Elliptic functions.—By Mr. G. T. WALKER : Physical optics.—By Mr. G. T. BENNETT : Linear and quadratic complexes.—*Easter term, 1900* :—By Mr. W. L. MOLLISON : Theory of potential and electrostatics.—By Mr. E. T. WHITTAKER : Analysis.—*Long vacation, 1900* :—By Professor G. H. DARWIN : Attraction and potential.

During the winter semester 1899–1900 the several universities mentioned below offer the following mathematical courses :

UNIVERSITY OF GIESSEN. By Professor M. PASCH : Functions of complex variables, four hours ; Seminar, two hours.—By Professor E. NETTO : Analytical mechanics, four hours ; Seminar, two hours.—By Professor R. HAUSSNER : Differential and integral calculus, four hours ; Perspective, two hours ; Theory of probabilities, one hour ; Exercises in the elements of higher mathematics, one hour.

UNIVERSITY OF MARBURG. By Professor F. SCHOTKY : Integral calculus, four hours ; General theory of functions, five hours ; Seminar, two hours.—By Professor A. E. HESS : Geometry of space, synthetic and analytic, four hours ; Theory of algebraic equations and determinants, four hours ; Seminar, two hours.—By Dr. F. DALWIGK : Introduction to higher mathematics and exercises, for hours ; Selected subjects of the theory of functions, two hours ; Exercises in the construction of mathematical models, one hour.

UNIVERSITY OF PRAGUE. By Professor F. Lippich : Theoretical mechanics, three hours ; Theory of capillarity, two hours ; Seminar, two hours.—By Professor G. PICK : Differential and integral calculus, three hours ; Algebraic analysis, two hours ; Seminar, two hours.—By Professor K. BOBEK : Curves and surfaces in space, two hours ; Descriptive geometry and constructions, four hours.

UNIVERSITY OF STRASSBURG. By Professor T. REYE : Analytical geometry of space (new methods), three hours ; Mathematical theory of elasticity of solid bodies, two hours ; Seminar, two hours.—By Professor H. WEBER : Integration of the partial differential equations of mathematical physics, four hours ; Introduction to higher mathematics, two hours ; Exercises in mathematical seminar, three hours.—By Professor G. ROTH : Algebraic analysis and determinants, three hours ; Analytical geometry of space, two hours ; Ordinary differential equations, two hours.—By Professor A. KRAZER : Differential and integral calculus, four hours ; Analytical geometry of the plane, three hours ; Exercises in infinitesimal calculus, two hours.—By Dr. E. TIMERDING : Vector analysis, two hours.—By Dr. J. WELLSTEIN : Descriptive geometry and exercises, four hours ; Seminar in coöperation with Professor WEBER, two hours.

UNIVERSITY OF TUBINGEN. By Professor A. VON BRILL : Introduction to higher mathematics, four hours ; Theory of algebraic curves, three hours ; Seminar, two hours.—By Professor H. STAHL : Higher analysis, three hours ; Partial differential equations, three hours ; Seminar, two hours.—By Professor L. MAURER : Descriptive geometry and exercises, three hours ; Elements of differential and integral calculus, two hours ; Exercises in algebra and geometry for students of natural science, two hours.

UNIVERSITY OF VIENNA. By Professor G. VON ESCHERICH : Elements of differential and integral calculus, five hours ; Exercises on the preceding course, two hours ; Proseminar, one hour ; Seminar, two hours.—By Professor L. GEGENBAUER : Algebra, four hours ; Spherical and cylindrical harmonics, one hour ; Proseminar, one hour ; Seminar, two hours.—By Professor F. MERTENS : On the laws of reciprocity, five hours ; Seminar, two hours ; Proseminar, one hour.—By Professor G. KOHN : Analytical geometry and exercises, four hours.—By Dr. V. SERSAWY : The mathematics of life insurance, two parts, of three and four hours, respectively.—By Dr. A. TAUBER : Insurance mathematics and exercises, six hours.—By Dr. K. ZINDLER : Differential equations, two hours.—By Dr. E. BLASCHKE : Introduction to mathematical statistics, three hours.

UNIVERSITY OF WURZBURG. By Professor F. PRYM : Differential calculus, four hours ; Higher theory of functions, four hours ; Seminar in differential calculus, two hours ; Seminar in selected sections of higher mathematics,

two hours.—By Professor A. VOSS : Analytical mechanics, four hours ; Exercises in analytical mechanics, two hours ; Algebra, three hours ; Seminar in synthetic and analytic geometry, one hour.

UNIVERSITY OF ZURICH. By Professor H. BURKHARDT : Differential and integral calculus, four hours ; mechanics, four hours ; Seminar, two hours.—By Dr. A. WEILER : Descriptive geometry and exercises, four hours ; Analytical geometry and exercises, four hours.—By Dr. F. KRAFT : Differential equations, three hours ; Analytical geometry, three hours ; Theory of probabilities, two hours ; Seminar, two hours.—By Dr. E. GUBLER, algebra, three hours ; spherical trigonometry, one hour ; methods of mathematical instruction, two hours.

ANDREW GRAY, F.R.S., professor of physics in the University of North Wales since 1884, has been appointed professor of natural philosophy in Glasgow University, to succeed Lord KELVIN, who recently resigned.

A STATUE erected in memory of the late Professor F. TISSERAND was unveiled at Nuits-Saint-Georges on the 15th of October.

MR. LINDSAY DUNCAN has been appointed instructor in mathematics at Union College, and MR. EDWIN HAVILAND has been made assistant in mathematics in Swarthmore College.

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## NEW PUBLICATIONS.

### I. HIGHER MATHEMATICS.

BURKHARDT (H.). See ENCYKLOPÄDIE.

BURNSIDE (W. S.) and PANTON (A. W.). Introduction to determinants; being a chapter from the theory of equations. London, Longmans, 1899. 8vo. 2s. 6d.

———. Theory of equations. 4th edition. Vol. I. London, Longmans, 1899. 8vo. 9s. 6d.

CAPELLI (A.). Lezioni di algebra complementare, ad uso degli aspiranti alla licenza universitaria in scienze fisiche e matematiche. 2a edizione con aggiunte. Napoli, Pellerano, 1898. 8vo. 16 + 680 pp. Fr. 8.50

CORDARA (S.). Nota sulla impossibilità della quadratura del cerchio. Bologna, Azzoguidi, 1899. 8vo. 11 pp.