

biaxial crystals by means of observations on total reflection. It would scarcely be possible to find a more detailed or simpler presentation of all this material. Many works on analytical or physical optics hardly mention these subjects at all except in the most general way. Several chapters further on in the work, the author takes up the physical basis for these results and develops the formulas from the electromagnetic conditions at the interface of two media.

There is little need of prolonging this review with the recitation of the course of the various chapters. Enough has been said to show the method upon which the author has constructed his book and the detail with which he has written. There is one point in which an improvement might be suggested. The plates which exhibit the elaborate and intricate phenomena of interference are all in black and white. This is a great pity; the beautifully modulated color schemes are the chief attraction of the figures and the author's detailed tables of the colors that are found in some special cases by no means take the place of the actual colors on the plates. If the coloring of the plates had to be done by the eye and hand, there might be good excuses for omitting it; but natural color photography is now so well developed that very good photographs of these effects can be obtained and reproduced.

The student of optics, who frequently finds it very hard to lay his hand upon a large and accurate presentation of the phenomena of crystalline optics, will refer constantly to this work and will feel under deep obligations to its author for the pains taken in preparing it.

E. B. WILSON.

NOTES.

THE July number (volume 10, number 3) of the *Transactions of the American Mathematical Society* contains the following papers: "Projective differential geometry of curved surfaces (fifth memoir)," by E. J. WILCZYNSKI; "On the osculating quartic of a plane curve," by W. W. DENTON; "Note on a system of axioms for geometry," by A. R. SCHWEITZER; "Irreducible homogeneous linear groups in an arbitrary domain," by W. B. FITE; "On the integration of the homogeneous linear difference equation of second order," by W. B. FORD; "On Cantor's theorem concerning the coefficients of a convergent

trigonometric series, with generalizations," by W. F. OSGOOD ; "Equivalence of pairs of bilinear or quadratic forms under rational transformation," by L. E. DICKSON ; "On a complete system of invariants of two triangles," by D. D. LEIB.

THE July number (volume 31, number 3) of the *American Journal of Mathematics* contains the following papers : "The birational transformations of algebraic curves of genus 4," by A. L. VAN BENSCHOTEN ; "On some loci associated with plane curves," by C. H. SISAM ; "Plane sections of a Weddle surface," by F. MORLEY and J. R. CONNER ; "The differential equation satisfying abelian theta functions of genus 3," by J. E. WRIGHT ; "Differential equations admitting a given group," by J. E. WRIGHT ; "On the angles of the regular polytopes of four dimensional space," by P. H. SCHOUTE.

THE concluding (July) number of volume 10 of the *Annals of Mathematics* contains : "Thermodynamic analogies for a simple dynamical system," by E. B. WILSON ; "Discussion of a method for finding numerical square roots," by C. L. BOUTON ; "On the direct product in the theory of finite groups," by J. H. MACLAGAN-WEDDERBURN ; "Existence of the generalized Green's function," by W. D. A. WESTFALL ; "The gambler's ruin," by J. L. COOLIDGE.

THE series of lectures announced in connection with the celebration, September 6-18, of the twentieth anniversary of the founding of Clark University included the following in mathematics : Professor E. H. MOORE, "The role of postulational methods in mathematics ;" Professor E. B. VAN VLECK, "The homogeneous linear difference equation of order n with polynomial coefficients, considered from the functional standpoint ;" Professor JAMES PIERPONT, "Modern theories of integration ." Discussions of the following topics were also announced : "The unification and continuity of mathematics in school and college ;" "The effectiveness of mathematical training," opened by Professor J. W. A. YOUNG ; "The use and abuse of textbooks in mathematical classes," opened by Dr. J. S. FRENCH.

THE next meeting of the British association for the advancement of science will be held at Sheffield, England, August 31 to September 10, 1910, under the presidency of T. G. BONNEY.

THE section of mathematics and physics of the royal society of Naples announces the following prize problem :

“A systematic exposition of the known concepts regarding configurations of planes and of spaces, putting them into closer relation with the theory of substitutions, and including, if possible, some new contributions.”

The value of the prize is 1000 lire. Competing memoirs must be written in Italian, Latin, or French, and be in the hands of the secretary of the academy before June 30, 1910.

THE prize of the Accademia dei Lincei of 10,000 lire, awarded for excellence in mathematical contributions, has been divided between Professor F. ENRIQUES, of the University of Bologna, and Professor T. LEVI CIVITA, of the University of Padua.

AN extensive laboratory for the construction of mathematical models and apparatus is being fitted up for the use of students of the Ecole Normale of the University of Paris, somewhat after the plan of that at Göttingen. It will be in charge of Professor E. BOREL.

ADVANCED courses in mathematics are announced for the winter semester 1909-1910 at the various German universities as follows :

UNIVERSITY OF BERLIN. — By Professor H. A. SCHWARZ : Analytic geometry, four hours ; Theory of analytic functions, II, four hours ; Geometry of conics, two hours ; Colloquium, two hours ; Seminar, two hours. — By Professor G. FROBENIUS : Theory of numbers, four hours ; Seminar, two hours. — By Professor F. SCHOTTKY : Theory of curves and surfaces, four hours ; Applications of elliptic functions, four hours ; Seminar, two hours. — By Professor G. HETTNER : Definite integrals, two hours. — By Professor J. KNOBLAUCH : Differential calculus, with exercises, five hours ; Theory of elliptic functions, four hours. — By Professor R. LEHMANN-FILHÈS : Integral calculus, four hours ; Determinants, four hours. — By DR. I. SCHUR : Theory of algebraic equations, four hours ; Theory of linear differential equations, four hours.

UNIVERSITY OF LEIPZIG — By Professor C. NEUMANN : Theory of potential and spherical harmonics, four hours ; Seminar, two hours. — By Professor O. HÖLDER : Elliptic functions, five hours ; Theory of finite groups, one hour ; Seminar, two hours. — By Professor K. ROHN : Analytic geometry of space, four hours ; Descriptive geometry with exercises, four hours ;

Seminar, two hours. — By Professor G. HERGLOTZ: Mechanics, four hours; Mechanics of continua, two hours; Seminar, two hours. — By Professor P. v. OETTINGEN: Elements of projective dioptics, one hour. — By Professor F. HAUSDORFF: Differential geometry with exercises, four hours; Algebraic numbers, two hours. — By Professor H. LIEBMANN: Differential and integral calculus with exercises, five hours.

UNIVERSITY OF MUNICH. — By Professor F. LINDEMANN: Differential calculus, five hours; Analytic mechanics, four hours; Seminar on line and spherical geometry, two hours. — By Professor A. VOSS: Analytic geometry of space, four hours; Theory of algebraic curves, four hours; Seminar on theory of surfaces, two hours. — By Professor A. PRINGSHEIM: Introduction to analytic functions, five hours. — By Professor A. SOMMERFELD: Vector analysis, three hours; Thermo-dynamics, three hours; Seminar, two hours. — By Professor H. BRUNN: Modern development of analysis situs, two hours. — By Professor K. DOEHLEMANN: Descriptive geometry, with exercises, eight hours; Synthetic geometry, with exercises, five hours; Graphical representation, two hours. — By Dr. G. HARTOGS: Theory of abelian functions, four hours. — By Dr. O. PERRON: Advanced calculus, with exercises, five hours; Theory of continued fractions, two hours.

UNIVERSITY OF STRASSBURG. — By Professor H. WEBER: Differential and integral calculus, four hours; Calculus of variations, two hours; Seminar, two hours. — By Professor F. SCHUR: Analytic geometry, four hours; Selected chapters of the theory of surfaces, two hours; Seminar, two hours. — By Professor J. WELLSTEIN: Partial differential equations, five hours; Seminar, one hour. — By Professor M. SIMON: Methods in elementary mathematics, four hours. — By Professor S. EPSTEIN: Determinants, four hours.

THE following advanced courses in mathematics are offered at the Italian universities during the academic year 1909–1910:

UNIVERSITY OF BOLOGNA. — By Professor C. ARZELÀ: Calculus of variations, integral equations, and Laplace's series, three hours. — By Professor L. DONATI: Thermodynamics, kinetic theory of gases, magneto- and electro-optics, three hours. — By Professor L. PINCHERLE: Elliptic functions, integrals of algebraic differentials, and abelian functions, three hours.

UNIVERSITY OF CATANIA. — By Professor M. DE FRANCHIS : Geometry on algebraic surfaces, three hours. — By Professor G. LAURICELLA : Integral equations, development in series of characteristic functions, with application to vibrating strings and membranes, four and a half hours. — By Professor G. PENNACCHIETTI : Applications of elliptic functions to mechanical problems, four and a half hours. — By Professor C. SEVERINI : Selected topics in differential geometry, three hours.

INSTITUTE OF FLORENCE. — By Professor T. BOGGIO : Applications of integral equations to mathematical physics, three hours.

UNIVERSITY OF GENOA. — By Professor E. E. LEVI : Differential and integral equations, four hours. — By Professor G. LORIA : Theory of geometric transformations, three hours. — By Professor O. TEDONE : Problems of elastic equilibrium, three hours.

UNIVERSITY OF NAPLES. — By Professor F. AMODEO : History of mathematics from Newton to Lagrange, three hours. — By Professor A. CAPELLI : Arithmetic theory of algebraic numbers, three hours. — By Professor R. MARCOLONGO : Hydrodynamics, three hours. — By Professor D. MONTESANO : Theory of geometric correspondences, four and a half hours. — By Professor E. PASCAL : Selected chapters in analysis, three hours. — By Professor L. PINTO : Electro-optics and Hertz's waves, four and a half hours.

UNIVERSITY OF PADUA. — By Professor F. D'ARCAIS : Theory of functions and integral equations, four and a half hours. — By Professor U. CISOTTI : Mathematical theory of elasticity with technical application, three hours. — By Professor A. FAVARO : The life and work of Archimedes, three hours. — By Professor P. GAZZANIGA : Theory of numbers, three hours. — By Professor T. LEVI-CIVITA : Equations of dynamics and principles of celestial mechanics, four and a half hours. — By Professor G. RICCI : Absolute differential calculus, equilibrium and motion of solid elastic bodies, four hours. — By Professor F. SEVERI : Theory of continuous groups, three hours. — By Professor G. VERONESE : Synthetic geometry of hyperspace, four hours.

UNIVERSITY OF PALERMO. — By Professor G. BAGNERA : Automorphic functions, three hours. — By Professor M. GEB-

BIA : Propagation of heat, and thermodynamics, four and a half hours. — By Professor G. B. GUCCIA : General theory of algebraic curves and surfaces, four and a half hours. — By Professor A. VENTURI : Figures of planets, particularly of the Earth, with regard to elasticity, three hours.

UNIVERSITY OF PAVIA. — By Professor E. ALMANSI : Theory of potential, electrostatics and magnetism, three hours. — By Professor L. BERZOLARI : Geometry of hyperspace, three hours. — By Professor R. BONOLA : Imaginary in geometry, projective generation of certain curves and surfaces, linear systems of conics and quadrics, three hours. — By Professor F. GERBALDI : Functions of a complex variable and abelian integrals, three hours. — By Professor G. VIVANTI : Theory of algebraic numbers, three hours.

UNIVERSITY OF PISA. — By Professor E. BERTINI : Abelian integrals with application to the geometry on an algebraic curve, three hours. — By Professor E. BIANCHI : Calculus of variations and integral equations, four and a half hours. — By Professor U. DINI : Linear differential equations with application to the development of a given function in series, four and a half hours. — By Professor E. A. MAGGI : Advanced theoretic mechanics, Maxwell's theory of electro-magnetic fields, and electrons, four and a half hours. — By Professor P. PISSETTI : Figures and rotations of celestial bodies, and spherical astronomy, three hours.

UNIVERSITY OF ROME. — By Professor G. CASTELNUOVO : Abelian functions and geometric applications, three hours. — By Professor V. CERRUTI : Partial differential equations of the first order, three hours. — By Professor L. ORLANDO : Dynamics of balloons and of aëroplanes, three hours. — By Professor L. SILBERSTEIN : Complements of dynamics, electro-magnetic fields, and optics, three hours. — By Professor V. VOLTERRA : Integral and integro-differential equations with applications, four and a half hours ; hydrodynamics and the theory of the tides, three hours.

UNIVERSITY OF TURIN. — By Professor G. PEANO : Mathematical logic, three hours. — By Professor G. SANNIA : Geometric applications of the calculus and intrinsic geometry, three hours. — By Professor C. SEGRE : Cubic surfaces and plane quartics, three hours. — By Professor C. SOMIGLIANA : Optics and electric oscillations, three hours.

THE University of Rochester has received, under the provisions of the will of the late Rear Admiral W. HARKNESS, professor of mathematics, U. S. Navy, almost his entire collection of astronomical instruments and a considerable part of his library.

PROFESSOR M. CANTOR, of the University of Heidelberg, has been elected associate member of the academy of sciences of Heidelberg.

PROFESSOR A. CAPELLI, of the University of Naples, Professor G. DARBOUX, of the University of Paris, and Professor Sir A. G. GREENHILL, formerly of the Ordnance College, Woolwich, have been elected foreign members of the royal institute of Venice.

PROFESSOR E. ALMANZI, of the University of Pavia, and Professor A. GARBASSO, of the University of Genoa, have been elected corresponding members of the Accademia dei Lincei.

PROFESSOR G. DARBOUX has been appointed the official delegate of the French government at the approaching Hudson-Fulton celebration.

THE title of Hofrat has been conferred upon Professor O. HÖLDER, of the University of Leipzig.

PROFESSOR L. MAURER, of the University of Tübingen, has been promoted to a full professorship of mathematics.

DR. R. E. V. MISES, of the technical school at Brünn, has been appointed associate professor of mathematics at the University of Strassburg.

PROFESSOR F. SCHUH, of Delft, has been appointed professor of analysis at the University of Groningen.

DR. C. E. WASTEELS has been appointed associate professor of rational mechanics at the University of Geneva.

PROFESSOR E. V. WEBER, of the University of Würzburg, has been promoted to a full professorship of mathematics.

DR. — BYDZOVSKY has been appointed docent in mathematics at the Bohemian University of Prague.

DR. T. J. I'A BROMWICH, of Cambridge University, has been promoted to an associate professorship of mathematics.

PROFESSOR F. PRYM, of the University of Würzburg, will retire from active service on October 1.

PROFESSOR A. GRÜNWARD, of the German technical school at Prague, has retired from regular teaching.

A MARBLE monument by G. Monteverde of the late Professor LUIGI CREMONA was unveiled with appropriate ceremonies at the engineering school of Rome on June 10.

PROFESSOR C. RUNGE, of the University of Göttingen, has been appointed Kaiser Wilhelm exchange professor of mathematics at Columbia University for the next academic year. The subject of his lectures will be "Graphical methods in physics and technic."

THE honorary degree of doctor of science has been conferred upon Professor E. H. MOORE, of the University of Chicago, by Yale University.

WILLIAMS COLLEGE conferred the degree of doctor of laws upon Professor H. B. FINE, of Princeton University, last June.

PROFESSOR R. MORRIS, of Rutgers College, has been promoted to a full professorship of mathematics and graphics.

PROFESSOR FLOYD FIELD, of the Georgia School of Technology, has been appointed full professor of mathematics and head of the department for 1909-1910.

AT Princeton University DR. E. SWIFT has been promoted to an assistant professorship of mathematics.

PROFESSOR C. N. HASKINS, of the University of Illinois, has accepted an assistant professorship of mathematics at Dartmouth College.

THE following changes are announced at the University of Illinois: Dr. C. H. SISAM, who returns after a year's study at Turin, has been promoted to an assistant professorship of mathematics. Dr. JACOB KUNZ, of the University of Michigan, has been appointed assistant professor of mathematical physics. During the coming year he will give courses in dynamics and in the theory of electrons. Dr. THOMAS BUCK, of the University of Chicago, has been appointed instructor in mathematics.

PROFESSOR W. A. MANNING, of Stanford University, has exchanged work with Mr. E. W. PONZER, of the University of Illinois, for the current academic year.

DR. J. H. MACLAGAN-WEDDERBURN has been appointed preceptor in mathematics at Princeton University.

DR. C. C. GROVE has been appointed instructor in mathematics at Columbia University.

DR. L. KARPINSKI, of the University of Michigan, will spend next year at study at Columbia University.

PROFESSOR SIMON NEWCOMB died at Washington, D. C., July 11, 1909. He was born in Nova Scotia March 12, 1835, and came to the United States when eighteen years old. For thirty-six years he was professor of mathematics at the United States Naval Academy, with especial duties at the Naval observatory at Washington, and for ten years he was professor of mathematics and astronomy at Johns Hopkins University, and co-editor of the *American Journal of Mathematics*. For his extensive contributions to astronomy, celestial mechanics and in particular to the theory of the motion of the moon he was the recipient of a large number of honorary degrees, medals, and prizes. He was a member of the National academy of science, foreign member of the Royal society of London, foreign associate of the Institute of France, knight of the order "Pour le mérite" für Kunst und Wissenschaft, and member of many other societies and academies. He was a member of the AMERICAN MATHEMATICAL SOCIETY from 1891, and its president during 1896-1898.

AT the meeting of the Paris academy of sciences on August 18, a eulogy on Professor SIMON NEWCOMB, late foreign associate of the academy, was pronounced by the permanent secretary, Professor G. DARBOUX.

PROFESSOR V. CERRUTI, of the University of Rome, died August 20, 1909, at the age of 59 years. He was director of the School of Engineers, Senator of the Kingdom of Italy, and member of the Accademia dei Lincei and of the Italian society of sciences.