a given order and weight and that every invariant form for f_n is the source of a covariant for f_{n+r}. All these results are generalized to apply to a system of simultaneous forms.

The concept of an invariant is extended to apply to certain transcendental forms, including the logarithm and the elliptic integrals. By means of the former it is shown that every symmetric function of the roots can be rationally expressed in terms of the sum of the powers of the roots and a number of related theorems are derived (Waring's formulas). It is now easy to derive the expressions for the discriminant of an equation, the resultant of two such equations, and the expressions for the elementary relative invariants in terms of the roots. A second volume is in preparation which is to extend the preceding theory to ternary and quaternary forms.

To students of analytic geometry and of algebraic functions Professor Meyer's treatise will be of real assistance.

VIRGIL SNYDER.

NOTES.

THE April number (volume 11, number 2) of the *Transactions of the American Mathematical Society* contains the following papers : " The theorem of Thomson and Tait and natural families of trajectories," by EDWARD KASNER ; " The introduction of ideal elements and a new definition of projective n-space," by F. W. OWENS ; " The groups of classes of congruent quadratic integers with respect to a composite ideal modulus," by ARTHUR RANUM ; " A simplified treatment of the regular singular point," by G. D. BIRKHOFF ; " The strain of a gravitating, compressible elastic sphere," by L. M. HOSKINS.

AT the meeting of the London mathematical society held on March 10 the following papers were read : By W. F. SHEPPARD, " Forms of the remainder in the Euler-Maclaurin sum formula "; by J. W. NICHOLSON, " The scattering of light by a large conducting sphere "; by Miss H. P. HUDSON, " The 3–3 birational space transformation."

THE following papers have been read at recent meetings of the Edinburgh mathematical society. January 19: by R. SANGANA,

"Series for calculating Euler's constant and the constant in Sterling's theorem"; by D. MC. SOMMERVILLE, "A problem in voting" and "Classification of geometries with projective matrix." February 11: by L. NAVANIENGAR, "The locus of points at which two sides of a given triangle subtend equal or supplementary angles"; by J. I. CRAIG, "Orthogonal trajectories in vectorial coordinates." March 11 : by G. P. CARSLAW, "The Bolyai-Lobachevsky non-euclidean geometry; an elementary interpretation and some results which follow from it"; by R. J. T. BELL, "The locus of the lines that intersect three given lines"; by R. C. ARCHIBALD, "Note on Wallace's line."

THE Royal academy of sciences, letters and arts of Belgium announces the following prize problems for 1911 :

" New investigations in the development of real or analytic functions in series of polynomials"; prize 800 francs.

"A summary of the various memoirs on systems of conics in space and a new contribution to the theory of these systems"; prize 600 francs.

Competing essays must be written in French or Flemish and sent to the secretary under the usual conditions before August 1, 1911.

THE publishing house of Gauthier-Villars in Paris announces the following additions to the series of monographs on the theory of functions edited by Professor E. BOREL: Principes de la théorie des fonctions entières de genre infini, by O. BLUMENTHAL ; Leçons sur la théorie de la croissance, by A. DENJOY ; Leçons sur les séries de polynomes à une variable complexe, by P. MONTEL ; Leçons sur le prolongement analytique, by L. ZORETTI ; L'inversion des intégrales définies, by V. VOLTERRA ; Quelques principes fondamentaux de la théorie des fonctions de plusieurs variables complexes, by P. COUSIN ; Leçons sur les correspondances entre variables réelles, by J. DRACH ; Leçons sur la fonction $\zeta(s)$ de Riemann et son application à la théorie des nombres premiers, by H. V. KOCH.

THE following courses in advanced mathematics are offered by the various American universities during the academic year 1910–1911.

CORNELL UNIVERSITY. — By Professor J. McMAHON : Theory of probabilities, two hours ; Vector analysis, two hours.

— By Professor J. H. TANNER : Theory of equations, three hours. — By Professor J. I. HUTCHINSON : Theory of functions of a complex variable, three hours. — By Professor V. SNYDER : Descriptive geometry, three hours ; Birational transformations, two hours, first term.   By Professor F. R. SHARPE : Mechanics, two hours. — By Professor W. B. CARVER : Advanced calculus, three hours. — By Professor A. RANUM : Theory of groups, two hours. — By Dr. D. C. GILLESPIE : Differential geometry, two hours. — By Dr. C. F. CRAIG : Applications to mechanics and physics, two hours. — By Dr. F. W. OWENS : Differential equations, two hours. — By Dr. J. V. McKELVEY : Advanced analytic geometry, three hours. — By Dr. L. L. SILVERMAN : Algebra of logic, two hours.

PRINCETON UNIVERSITY. — By Professor H. B. FINE : Theory of algebraic numbers, three hours, first term. — By Professor H. D. THOMPSON : Coordinate geometry, three hours. — By Professor L. P. EISENHART : Mechanics, three hours ; Differential geometry, three hours. — By Professor O. VEBLEN: Linear groups and invariants, three hours, second term ; Projective geometry, II, three hours, first term ; Projective geometry, I, three hours. — By Professor G. D. BIRKHOFF : Differential equations, three hours ; Differential equations of physics, three hours. — By Professor E. SWIFT : Theory of functions of a complex variable, I, three hours.— By Professor J. H. McL. WEDDERBURN: Theory of functions of a complex variable, II, three hours, second term.

YALE UNIVERSITY. — By Professor J. PIERPONT : Abelian functions, two hours ; Thermodynamics, two hours ; Theory of functions of a complex variable, two hours ; Modern analytic geometry, two hours. — By Professor P. F. SMITH: Geometrical analysis, one hour ; Differential geometry, two hours ; Elementary differential geometry, two hours. — By Professor E. W. BROWN : Elementary mechanics, two hours ; Advanced mechanics, two hours ; Advanced calculus, three hours. — By Professor W. R. LONGLEY : Calculus of variations, two hours ; Potential theory and harmonic analysis, one hour. — By Dr. A. W. GRANVILLE : Elementary differential equations, one hour. — By Dr. G. M. CONWELL : Finite groups, two hours ; Partial differential equations of physics, one hour. — By Dr. G. F. GUNDELFINGER : Advanced analytic geometry, two hours. — By Dr. D. D. LEIB : Transformations of space, two hours.

THE following courses in mathematics are announced for the summer semester, 1910.

UNIVERSITY OF STRASSBURG. — By Professor H. WEBER : Definite integrals and introduction to the theory of functions, four hours ; Algebra, two hours ; Seminar, two hours. — By Professor F. SCHUR : Projective geometry, four hours ; Theory of ordinary differential equations, two hours ; Seminar, two hours. — By Professor J. WELLSTEIN : Forms and matrices, two hours ; Vector analysis, three hours ; Seminar, two hours. — By Professor L. v. MISES : Graphical statics, two hours ; Aërial mechanics, two hours. — By Professor P. EPSTEIN : Introduction to higher mathematics, two hours. — By Professor M. SIMON : Algebraic analysis in connection with the methods of elementary arithmetic, two hours.

FOR the year 1908–1909 the list of doctorates with mathematics as the major subject conferred by German universities is as follows (the list for 1906–1908 appeared in the February BULLETIN, pages 268–274) :

Berlin.

LICHTENSTEIN, L. "Zur Theorie der gewöhnlichen Differentialgleichungen und der partiellen Differentialgleichungen zweiter Ordnung. Die Lösungen als Funktionen der Randwerte und der Parameter."

Breslau.

FREUND, E. "Entwickelung willkürlicher Funktionen vermittelst meromorpher."

GOLDMAN, F. "Poncelet'sche Polygone bei Kreisen."

JOPKE, A. "Synthetische Untersuchungen über lineare Kegelschnittsysteme erster, zweiter, und dritter Stufe."

KLIEM, F. "Ueber Oerter von Treffgeraden entsprechender Strahlen in eindeutig und linear verwandten Strahlengebilden erster bis vierter Stufe."

Giessen.

LEPPER, H. "Ueber die invarianten Bildungen von Formen mit digredienten Schichten von Variabeln."

SCHMIDT, K. "Untersuchungen über Kurven dritter Ordnung im Anschluss an eine Grassmann'sche Erzeugungsweise."

WAGNER, R. " Ueber binäre bilineare und quaternäre quadratische Formen."

Göttingen.

BOLTZE, E. " Grenzschichten an Rotationskörpern in Flüssigkeiten mit kleiner Reibung."

HARR, A. " Zur Theorie der orthogonalen Funktionensysteme."

IHLENBURG, W. " Ueber die geometrischen Eigenschaften der Kreisbogenvierecke."

KOCH, H. " Ueber die praktische Anwendung der Runge-Kuttaschen Methode zur numerischen Integration von Differentialgleichungen."

SCHIMMACK, R. " Axiomatische Untersuchungen über die Vektoraddition."

SPEISER, A. " Die Theorie der binären quadratischen Formen mit Koeffizienten und Unbekannten in einem beliebigen Zahlkörper."

Greifswald.

FINKE, P. " Ueber Schaaren von ∞^5 Kurven im gewöhnlichen Raume."

HAUSSLEITER, H. " Zur Theorie der Pfaffschen Systeme."

LIER, O. " Ueber Flächenschaaren, die durch Berührungstransformation in Kurvenschaaren überführbar sind."

WERNER, A. " Ueber Systeme von drei Pfaffschen Gleichungen im Raume von fünf Dimensionen."

ZIEMKE, E. " Ueber partielle Differentialgleichungen erster Ordnung mit Integralvereinen, die als Punktmannigfaltigkeiten zweifach ausgedehnt sind."

Halle.

BOLDMANN, O. " Zur Theorie der übergeschlossenen Gelenkmechanismen."

JONAS, H. J. " Ueber W-Strahlensysteme, Flächendeformation und äquidistante Kurvenschaaren."

Jena.

GÜNTZEL, F. " Ueber Gruppierungen und Realitätsverhältnisse gewisser Punkte bei Raumkurven vierter Ordnung erster Spezies."

ROEGNER, M. "Die Steiner'sche Hypocykloide."

Kiel.

JANSEN, H. "Lückenlose Ausfüllung des R_n mit gitterförmig angeordneten n-dimensionalen Quadern."

NEUENDORFF, R. "Ueber Kreispunktpolarkurven."

Königsberg.

NEUMANN, A. "Ueber quadratische Verwandtschaften in Ebene und Raum, insbesondere Kreis- und Kugelverwandtschaften."

Leipzig.

FÖRSTER, R. "Beiträge zur specielleren Theorie der Riemannschen P-Funktionen 3ter Ordnung."

MEYER, C. "Zur Theorie des logarithmischen Potentials."

Munich.

BERWALD, L. "Krümmungseigenschaften der Brennflächen eines geradlinigen Strahlensystems und der in ihm enthaltenen Regelflächen."

BÖHM, F. "Parabolische Metrik im hyperbolischen Raum."

BURMESTER, H. "Untersuchung der wahren Hellegleichen auf der Kugel nach dem Lommel-Seeligerschen Satz."

DEBYE, P. "Der Lichtdruck auf Kugeln von beliebigem Material."

DEGENHART, H. "Ueber einige zu zwei ternären quadratischen Formen in Beziehung stehende Konnexe."

HOWLAND, L. A. "Anwendung binärer Invarianten zur Bestimmung der Wendetangenten einer Kurve dritter Ordnung."

NOETHER, F. "Ueber rollende Bewegung einer Kugel auf Rotationsflächen."

SCHMID, A. "Anwendung der Cauchy-Lipschitz'schen Methode auf lineare partielle Differentialgleichungen."

ZAPP, E. "Untersuchung eines speziellen Falles des Drei- und Vierkörperproblems."

Rostock.

JECKE, R. H. " Beiträge zur Geometrie der Bewegung."

LANGE, M. " Vereinfachte Formeln für die trigonometrische Durchrechnung optischer Systeme."

Strassburg.

MALESSA, G. " Fokale Eigenschaften korrelativer Grundgebilde."

Tübingen.

CASPER, M. " Ueber die Darstellbarkeit der homomorphen Formenschaaren durch Poincaré'sche Z-Reihen."

FRITZ, H. " Die Darstellung willkürlicher Funktionen in Anwendung auf die Statistik."

OEHLER, H. " Ueber die Gleichungssysteme, welche man aus einer Matrix variabler Elemente durch Nullsetzen der Determinanten gegebener Ordnung erhält.

Würzburg.

WIDDER, W. " Untersuchungen über die allgemeinste lineare Substitution mit vorgegebener $p$ter Potenz."

ZILLING, J. " Ueber die infinitesimale Deformation der Minimalflächen."

DURING the academic year 1908–1909 the following doctorates with mathematics as the major subject were conferred by the University of Paris :

DIENNES, P. " Essai sur les singularités des fonctions analytiques."

GAMBIER, B. " Sur les équations différentielles du second ordre et du premier degré dont l'intégrale générale est à points critiques fixes."

VERONE, T. "Contribution à la théorie des ondes liquides."

MR. L. N. G. FILON, professor of pure mathematics in University College, London, and Mr. G. H. HARDY, fellow and mathematical lecturer in Trinity College, Cambridge, have been elected to membership in the Royal Society of London.

MR. G. I. TAYLOR, of Trinity College, Cambridge, was awarded a first Smith's prize for his essay on " Discontinuous motion in gases."

DR. E. MEISSNER, of the technical school of Zürich, has been promoted to a professorship of rational mechanics.

PROFESSOR H. HEEGAARD, of the military academy at Waedbeck, has been appointed professor of mathematics at the University of Copenhagen, as successor to Professor H. G. ZEUTHEN, who will retire at the close of the present academic year.

PROFESSOR A. S. CHESSIN has recently delivered lectures on the modern theory of the gyrostat at the U. S. Naval Academy and at Lafayette College.

AT Columbia University, Professor EDWARD KASNER has been promoted to a full professorship of mathematics. Mr. H. B. CURTIS has been appointed instructor in mathematics in Barnard College.

AT Cornell University, Dr. F. R. SHARPE, Dr. W. B. CARVER and Dr. A. RANUM have been promoted to assistant professorships of mathematics. Mr. W. A. HURWITZ and Mr. E. J. MILES have been appointed instructors in mathematics.

MR. A. S. HAWKESWORTH has been appointed professor of higher mathematics at the University of Pittsburg.

AT Haverford College, Professor A. H. WILSON, of the Alabama Polytechnic Institute, has been appointed associate professor of mathematics, as successor to Professor W. H. JACKSON, who returns to England.