

become a terrible and discordant jangle after a few reflections, interferences, rotations, and the like. Certainly the introduction of this additional stringiness adds a considerable complication to our conception of the ether, which for the most part has always been regarded as homogeneous except as to points (matter) rather than lines (Faraday tubes). There seem to be, however, phenomena † which this picture explains. Perhaps the universe does indeed look like a tremendous boiling pot of spaghetti. On this point Föppl and Abraham are silent.

After thus developing at some length a few points which the *Theorie der Elektrizität* has suggested, we shall not take away the zest of the reader by entering into details of the work under review. It remains to state in closing that in the revision the modern point of view is so fully adopted and the connections with the older theories so little discussed that one who had been brought up on the old would have some difficulty in immediately comprehending the new, notwithstanding its logical excellence and clear exposition. But the utility of modulations has largely vanished during the past decade, and Abraham is undoubtedly right in omitting them. This book is written by the young school for the young school — and we wish it an increase of its deserved success. The second volume will be awaited with impatience.

EDWIN BIDWELL WILSON.

YALE UNIVERSITY,
February, 1904.

NOTES.

THE seventeenth regular meeting of the Chicago Section of the AMERICAN MATHEMATICAL SOCIETY will be held at the University of Chicago on Saturday, April 22. Titles and abstracts of papers to be presented at this meeting should be in the hands of the Secretary of the Section, Professor THOMAS F. HOLGATE, 617 Hamline Street, Evanston, Ill., not later than April 8.

THE Macmillan Company is about to issue for the AMERICAN MATHEMATICAL SOCIETY a volume of 187 pages, of BULLETIN size, containing the lectures delivered before the

* Thomson, *loc. cit.*

Boston Colloquium, September 2–5, 1903, by H. S. WHITE: "Linear systems of curves on algebraic surfaces"; F. S. WOODS: "Forms of non-euclidean space"; E. B. VAN VLECK: "Selected topics in the theory of divergent series and of continued fractions." The price of the volume is \$2.00; to members of the Society, \$1.50. Subscriptions should be sent to The Macmillan Company, 66 Fifth Avenue, New York, N. Y.

THE annual meeting of the British mathematical association was held at King's College, Cambridge, January 28. Professor G. B. MATHEWS was elected president for the ensuing year. The following papers were read: by Mr. E. N. LANGLEY, "Models and their uses"; by Mr. W. H. WAGSTAFF, "On the new geometry"; by Professor A. R. FORSYTH and Mr. A. W. SIDDONS, "Should Greek be compulsory for candidates in mathematics at Cambridge?"

AT the meeting of the London mathematical society held on February 9 the following papers were read: by Dr. E. W. HOBSON, "General theory of transfinite numbers and order types"; by Mr. P. W. WOOD, "On the reducibility of covariants of binary quantics of infinite order, II."

A MEETING of the New York section of the Association of teachers of mathematics in the Middle States and Maryland was held March 4 at the College of the City of New York. A paper on "The graph in early algebra" was read by Professor J. Bowden, and Mr. Denbrigh, Mr. O. W. Anthony and Miss N. S. Ingalls, discussed "The first year of algebra." President J. H. Finley, of the College of the City of New York, addressed the meeting.

THE seventy-fifth annual meeting of the British association for the advancement of science will be held at Cape Town, South Africa, August 15–18, and at Johannesburg, August 29–31, under the presidency of Professor G. H. DARWIN. Applications for membership in the association must be received by May 31. The president of section A (mathematics and physics) is Professor A. R. FORSYTH.

THE Adams prize for 1904 was not awarded. The subject for the prize for 1906 (to be awarded in March 1907) is to dis-

cuss the inequalities of the moon's motion due to the direct action of the planets. Any one may compete for the prize who has at any time been admitted to a degree in Cambridge University. The essays must be sent to the vice-chancellor on or before December 16, 1906. The value of the prize is about 225 pounds sterling.

THE Smith's prizes for the present year have been awarded to H. BATEMAN, for his essay "The solution of linear differential equations by means of definite integrals," and to P. E. MARRACK, for his essay "Absorption by matter of Röntgen and γ -rays."

THE annual list of prize questions of the Dutch royal academy recently issued includes the following problem in mathematics: "In the case of constant curvature, the determination of the volume of the tetrahedron in elliptic space of three dimensions reduces to that of the hyperspace tetrahedron (extension of the notion of spherical trigonometry) in space of four dimensions. It is required to collect the literature relative to the determination of the latter volume and to extend the theory in some important point." (See the memoir of Schläfli, *Nieuw Archief voor Wiskunde*, 2d series, volume 6, 2d part, page 199.) The prize is 150 florins.

THE following books are announced as in the press of B. G. Teubner, Leipzig; Encyclopädie V, 1, 2, VI, 1, 1, VI, 2, 1; Encyclopédie I 1, 2, I, 2, 1, I, 3, 1, I, 4, 1; L. HEFFTER and C. KÖHLER, "Einführung in die analytische Geometrie der Ebene und des Raumes I"; W. F. OSGOOD, "Allgemeine Funktionentheorie, I"; E. SCHRÖDER, "Vorlesungen über die Algebra der Logik, II, 2"; O. STOLZ and J. GMEINER, "Funktionentheorie, II"; E. VIVANTI and A. GUTZMER, "Theorie der eindeutigen analytischen Funktionen"; J. THOMAE, "Formeln und Sätze aus dem Gebiete der elliptischen Funktionen, nebst Anwendungen."

THE following courses will be offered by the various universities during the summer semester, 1905. Lectures will begin about May 3, on account of the lateness of Easter.

UNIVERSITY OF BERLIN. — By Professor H. A. SCHWARZ: Integral calculus, four hours; Applications of elliptic functions,

two hours ; Hypergeometric series, two hours ; Colloquium, two hours. — By Professor G. FROBENIUS : Theory of algebraic equations, II, four hours. — By Professor F. SCHOTTKY : Linear differential equations, four hours. — By Professor J. KNOBLAUCH : Theory and application of determinants, four hours ; Surfaces and twisted curves, II, four hours ; Selected chapters of elliptic functions, one hour. — By Professor R. LEHMANN-FILHÉS : Differential calculus, four hours ; with exercises, one hour. — By Professor G. HETNER : Transcendental nature of π and e . — By Dr. E. LANDAU : Introduction to the theory of functions, two hours. By Dr. I. SCHUR : Analytic geometry, four hours ; Theory of numbers, II : algebraic and ideal numbers, four hours.

UNIVERSITY OF BERN. — By Professor J. H. GRAF : Bessel functions, three hours ; Elliptic functions, three hours ; Definite integrals and gamma functions, three hours ; Theory of functions, two hours ; Differential equations, II, two hours ; Differential and integral calculus, two hours ; Insurance and investments, two hours ; Seminar, two hours. — By Professor E. OTT : Differential calculus, two hours ; Analytic geometry of the plane, I, two hours ; Analytic geometry of space, two hours. — By Professor G. SIDLER ; Geometric exercises, two hours. — By Professor G. HUBER : Analytic geometry of quadrics, two hours. — By Dr. A. BENTELI : Descriptive geometry, four hours ; with exercises, three hours. — By Dr. C. MOSER : Introduction to life-insurance, two hours ; Seminar (with Professor Graf), two hours. — By Dr. L. CRELIER : Central projection, two hours ; Synthetic geometry, two hours.

UNIVERSITY OF BONN. — By Professor E. STUDY : Mechanics, II, three hours ; Methods of geometric depiction, three hours. By Professor G. KOWALEWSKI : Theory of determinants, two hours ; Theory of differential equations, four hours ; with exercises, one hour ; Theory of sets of points and foundations of the theory of functions, one hour. — By Professor FR. LONDON : Elements of the differential and integral calculus, four hours ; with exercises, one hour ; Descriptive geometry, II, with exercises in drawing, three hours. The Seminar will be conducted by Professors Study, Kowalewski and London, one hour.

UNIVERSITY OF Breslau. — By Professor J. ROSANES : Analytic geometry of the plane, four hours ; Theory of in-

variants, two hours; Seminar, one hour. — By Professor R. STURM: Theory of geometric relations, four hours; Curves and surfaces of the third order, two hours; Seminar, two hours. — By Professor G. LANDSBERG: Integral calculus, four hours; with exercises, one hour. — By Professor A. KNESER: Encyclopedia of elementary mathematics, four hours; Partial differential equations of mathematical physics, four hours; Seminar, two hours; Seminar for beginners, two hours.

UNIVERSITY OF FREIBURG. — By Professor J. LÜROTH: Elliptic functions, four and one half hours; Numerical calculation, two hours. — By Professor L. STICKELBERGER: Integral calculus with exercises, five hours; Infinitesimal geometry, three hours; Seminar, two hours. — By Professor A. LOEWY: Algebraic equations, four hours; Foundations of geometry, two hours. — By Dr. K. SEITH: Elementary treatment of conics, two hours.

UNIVERSITY OF HALLE. — By Professor G. CANTOR: Analytic mechanics, five hours; Descriptive geometry, four hours; Seminar, two hours. — By Professor A. WANGERIN: Elliptic functions, five hours; Spherical astronomy and mathematical geography, three hours; Conformal depiction, one hour; Seminar, two hours. — By Professor V. EBERHARD: Differential calculus, four hours; with exercises, one hour. — By Professor F. BUCHHOLZ: Applications of the calculus of variations to higher mechanics, four hours. — By Dr. F. BERNSTEIN: Analytic geometry of the plane, three hours; Elements of the theory of differential equations, two hours.

UNIVERSITY OF HEIDELBERG. — By Professor L. KOENIGSBERGER: Differential and integral calculus, four hours; Theory of functions, four hours; Seminar, two hours. — By Professor E. VALENTINER: Theory of planetary orbits, four hours. — By Professor M. CANTOR: Algebraic analysis, four hours; Arithmetic and algebra for students in political economy, three hours. — By Professor K. KOEHLER: Analytic geometry of the plane, three hours; Descriptive geometry, two hours. — By Professor K. BOEHM: Elementary mathematics (geometry), four hours; Helmholtz's theory of vortex motion, two hours.

UNIVERSITY OF JENA. — By Professor G. FREGE: Mechanics, I, four hours; Seminar, two hours. — By Professor A.

GUTZMER: Differential calculus with exercises, four hours; Differential equations, four hours. — By Professor J. THOMÆ: Plane analytic geometry, four hours; Ultra-elliptic functions, two hours. — By Professor R. RAU: Technical mechanics, four hours; Seminar in drawing, three hours.

UNIVERSITY OF KIEL. — By Professor L. POCHHAMMER: Analytic geometry of the plane, four hours; Theory of definite integrals, four hours; Seminar, one hour. Professor Stäckel's successor has not been announced, but the following courses will be given: Differential calculus and introduction to higher analysis, four hours; Analytic mechanics, four hours; Seminar, one and one half hours. — By Dr. E. WEINNOLDT: Descriptive geometry, four hours.

UNIVERSITY OF LEIPZIG. — By Professor C. NEUMANN: Selected chapters of mathematical physics, four hours; Seminar, one hour. — By Professor A. MAYER: Ordinary differential equations, four hours; with exercises, one hour. — By Professor O. HÖLDER: Introduction to the theory of algebraic equations, two hours; General theory of functions, four hours; Seminar, one hour. — By Professor K. ROHN: Analytic geometry of the plane, four hours; with exercises, one hour; Descriptive geometry, I, two hours; with exercises, two hours. — By Professor E. VON OETTINGEN: Geometric perspective drawing, two hours. — By Professor F. HAUSDORFF: Differential geometry, four hours. — By Professor H. LIEBMANN: Theory of definite integrals, three hours; Noneuclidean geometry, two hours. — By Professor O. FISCHER: Introduction to the mathematical treatment of the natural sciences, three hours. — By Professor H. BRUNS: Theory of probabilities, four hours; Seminar for numerical calculation, two hours.

UNIVERSITY OF MUNICH. — By Professor F. LINDEMANN: Analytic geometry of space, five hours; Definite integrals and Fourier's series, four hours; Seminar, two hours. — By Professor A. VOSS: Introduction to the theory of invariants, four hours; Selected chapters in the theory of surfaces, four hours; Seminar, two hours. — By Professor A. PRINGSHEIM: Integral calculus, five hours; exercises and applications, two hours. — By Professor L. GRAETZ; Analytic mechanics, II., four hours; Theory of heat and kinetic gas theory, four hours. — By Professor K. DOEHLEMANN: Descriptive geometry, II., three

hours ; with exercises, two hours ; Graphical statics, with exercises, three hours. — By Professor E. v. WEBER : Differential calculus, four hours ; with exercises, two hours ; Algebraic analysis, four hours. — By Dr. H. BRUNN : Elements of higher mathematics for students of all faculties, four hours.

UNIVERSITY OF WÜRZBURG. — By Professor F. PRYM : Theory of ordinary differential equations, four hours ; Proseminar on the calculus, two hours ; Seminar on theory of functions, two hours. — By Professor E. SELLING : Differential and integral calculus, four hours ; Probabilities and adjustment of errors, two hours ; Insurance, two hours. — By Professor G. ROST : Analytic and synthetic geometry of conics, four hours ; Descriptive geometry, II, four hours ; Analytic mechanics, II, four hours ; Algebraic curves, two hours ; Seminar, four hours.

DURING the year 1904 the following doctorates were conferred in mathematics by the university of Paris (the title of the dissertation is given in each case) : R. D'ADHÉMAR, "On a class of partial differential equations of the second order, of hyperbolic type, in three or four independent variables" ; S. BERNSTEIN, "On the analytic nature of the solutions of partial differential equations of the second order" ; E. ESCLANGON, "Quasi-periodic functions" ; S. POTRON, "The groups of order p^6 " ; P. VANDEUREN, "Theory of continuous bilinear fields" ; G. DUMAS, "On the functions of algebraic character in the region of a given point."

ON February 13 occurred the centenary of the birth of G. LEJEUNE DIRICHLET. The day was appropriately celebrated by the mathematical society of Göttingen, before which Professor H. Minkowski gave an address on the position of Dirichlet in mathematics. The current number (number 1, volume 129) of *Crelle's Journal* is also dedicated to the memory of Dirichlet. It contains a portrait drawing of Dirichlet on his deathbed, besides memoirs on the theory of numbers by Dedekind, Hilbert, Hensel and Mirimanoff.

PROFESSOR P. STÄCKEL, of the University of Kiel, has been appointed professor of mathematics at the technical school at Hanover.

PROFESSOR ROTH, professor emeritus of the University of Strassburg, has been decorated with the order of the crown of the third class.

DR. E. JAHNKE has been appointed professor of mathematics

in the mining academy at Berlin, as successor to Professor A. Kneser.

DR. A. MACFARLANE is preparing an extensive history of British mathematicians of the nineteenth century for the *Abhandlungen zur Geschichte der Mathematik*. He will deliver a course of six lectures on the same subject at Lehigh University, April 7 to April 17.

AT the Ecole Polytechnique, of Paris, Dr. M. PAINLEVÉ has been appointed professor of mechanics, as successor to Professor Léauté, who has retired with the title of honorary professor.

PROFESSOR P. BARBARIN, of Bordeaux, is preparing a French translation of Professor G. B. Halsted's Rational Geometry.

DR. E. BOREL has been appointed professor of the theory of functions at the University of Paris.

PROFESSOR M. LERCH, of the University of Freiburg, Switzerland, has been elected a corresponding member of the royal society of Liège.

THE honorary degree of doctor of science has been conferred upon Professor R. S. WOODWARD, of Columbia University, by the University of Pennsylvania.

AT Princeton University, Professor E. O. LOVETT has been appointed professor of astronomy, as successor to Professor C. A. YOUNG, who has been made professor emeritus.

PROFESSOR W. C. ESTY, Walker professor of mathematics at Amherst College, has resigned, after forty three-years of service. He will be succeeded by his son, Professor T. C. ESTY, of the University of Rochester.

MR. ROBERT TUCKER, editor of Clifford's mathematical papers, and secretary of the London mathematical society for thirty-five years, died January 29, at the age of 72 years.

PROFESSOR GUIDO HAUCK, of the technical school of Charlottenburg, well known for his writings on perspective and constructive geometry, died January 25 at the age of 59 years.

THE death is also announced of Professor J. C. V. HOFFMANN, founder of the *Zeitschrift für mathematischen und naturwissenschaftlichen Unterricht*, on January 21, at the age of 80 years.