section of an angle and various pieces of apparatus designed to solve the same problems are described and their theory discussed.   Later some interesting constructive approximations are given.

The properties of various transcendental curves are used to obtain approximately an $n$th root and to divide any angle into $n$ equal parts.   The division of the circle and of the arc of the lemniscate into $n$ equal parts for special values of $n$ with the aid of ruler and compass alone is discussed.

A development of attempts to arrive at the value of $\pi$ from the time of Ahmes to that of Lindemann is presented.   This leads naturally to mechanical quadrature and rectification.

Under the heading of analytic approximations are included such titles as Taylor's series, Lagrange's interpolation formula, exponential series with application to the quadrature of the hyperbola, De Moivre's theorem, indeterminate forms, and the determination of $\pi$ by the use of series.

The discussion of the irrationality of $\pi$ and $\pi^2$ brings out the methods used by famous mathematicians of old.   The book closes with the proof of the transcendental nature of $e$ and $\pi$.

There is much concrete work in algebra and geometry throughout the book, consequently a chance for errors, many of which have been listed in an appendix of two pages.

Student's mathematical clubs in our universities desiring some interesting material for the rounding out of a course in mathematics would find the volume rich in suggestions.

ERNEST W. PONZER.

## NOTES.

THE sixth regular meeting of the Southwestern Section of the American Mathematical Society will be held at the University of Kansas on Saturday, November 30.   Titles and abstracts of papers to be presented at this meeting should be in the hands of the chairman of the programme committee, Professor J. N. Van der Vries, University of Kansas, by November 8.

THE annual meeting of the Society will be held this year at Cleveland, Ohio, in affiliation with the American association

for the advancement of science, on Tuesday, Wednesday, and Thursday, December 31–January 2. The winter meeting of the Chicago Section will be merged with the annual meeting. Titles and abstracts of papers should be sent to the Secretary of the Society, 501 West 116th Street, New York, on or before December 10.

THE twentieth summer meeting of the Society will be held at the University of Wisconsin early in September, 1913. At the seventh colloquium of the Society, held in connection with this meeting, courses of lectures will be delivered as follows: By Professor W. F. OSGOOD: "Selected topics in the theory of analytic functions of several complex variables." By Professor L. E. DICKSON: "Certain aspects of a general theory of invariants, with special consideration of algebraic and modular invariants."

THE concluding (October) number of volume 34 of the *American Journal of Mathematics* contains: "Simple groups from order 2001 to order 3640," by L. P. SICELOFF; "On certain orthogonal systems of lines and the problem of determining surfaces referred to them," by A. E. YOUNG; "Wallace's theorem concerning plane polygons of the same area," by W. H. JACKSON; "On harmonic functions," by R. A. HARRIS; "Curves on quintic scrolls," by F. B. WILLIAMS; "On the structure of forms, and the algebraic theory of $n$-lines," by O. E. GLENN.

THE opening (September) number of volume 14 of the *Annals of Mathematics* contains the following papers: "Three-dimensional chains and the associated collineations in space," by HAZEL H. MACGREGOR; "Determination of the constants in Euler's problem concerning the minimum area between a curve and its evolute," by E. J. MILES; "Theorems on reducible quantics," by O. E. GLENN; "A determinant formula for the number of ways of coloring a map," by G. D. BIRKHOFF.

AT the meeting of the Edinburgh Mathematical Society on June 14 the following papers were read: By Professor H. S. CARSLAW, "A problem in the linear flow of heat discussed from the point of view of the theory of integral equations"; by D. G. TAYLOR, "Linear substitutions and their invariants"; by WM. BRASH, "Two general results in the differential calculus."

THE International commission on the teaching of mathematics made its report at the Fifth international congress of mathematicians at Cambridge, England, in August.  Reports were received from eighteen countries, and 150 separate reports were submitted.  About fifty more are now in process of preparation, and others are contemplated by various countries.  The central committee, consisting of Professor F. KLEIN (Göttingen), Sir GEORGE GREENHILL (London), and Professor H. FEHR (Geneva), with Professor DAVID EUGENE SMITH (New York) added, was continued in office for another period of four years.  The American reports have been completed and may be obtained gratis by application to the Bureau of Education, Washington, D.C.  It is probable that one or more reports, summarizing the larger features of the reports of all other countries, will be prepared by the American commission during the next four years, and that certain other special lines of work will be undertaken.  The central committee contemplates holding three international conferences on teaching, the first in France in 1914, the second in Germany in 1915, and the third, with the next congress, in Stockholm in 1916.

THE fourteenth meeting of the Australasian association for the advancement of science will be held at Melbourne in January, 1913.

THE eighty-second annual meeting of the British association for the advancement of science was held at Dundee during the week from September 4–11 under the presidency of Professor E. A. SCHÄFER.

The meeting was divided into twelve sections, Section A, mathematics and physics, being under the chairmanship of Professor H. L. CALLENDAR.  Programmes of the proposed proceedings for the day appeared each morning, together with the abstracts of the papers that were presented the preceding day, and the entertainments for each day, of which there was a very generous provision.

The following papers were presented before section A: Presidential address, "The nature of heat," by H. L. CALLENDAR; "The heating effect of radium emanation and its products," by E. RUTHERFORD and H. ROBINSON; "On the discharge of ultraviolet light of high-speed electrons," by R.

A. MILLIKAN; "Sur une nouvelle machine algébrique," by M. A. GERARDIN; "On Mersenne's numbers," by A. CUN-NINGHAM; "On arithmetic factors of the Pellian terms," by A. CUNNINGHAM; "Atomic heat of solids," by F. A. LINDE-MANN; "The algebraic numbers derived from the permutations of any assemblage of objects," by P. A. MACMAHON; "A mode of composition of positive quadratic forms," by E. H. MOORE; "Proof of a general theorem relating to orders of coincidence," by J. C. FIELDS; "The use of the exponential curve in graphics," by H. B. HEYWOOD; "Report on Bessel and other functions," by the committee appointed for that purpose. A number of other papers not of mathematical content were read before this section. In Section M, educational science, a symposium was devoted to the present position of mathematical teaching, in which papers were read by T. P. NUNN, P. PINKERTON, W. P. MILNE, and W. D. EGGAR.

The association has granted £30 to its committee, under the chairmanship of Professor M. J. M. HILL, for the continuation of the work of tabulating the Bessel functions.

The next meeting of the association will occur in Birmingham under the presidency of Sir W. H. WHITE.

THE one hundred and second edition of the complete catalogue of the publishing house of B. G. Teubner, Leipzig and Berlin, is dedicated to the Fifth international congress of mathematicians at Cambridge, and copies were presented to interested members. As frontispiece it contains a portrait of Euler, and three other photographic plates are contained in the volume; one shows the photographs of a number of prominent leaders in the organization of the Encyclopedia, another has a similar list from the "Kultur der Gegenwart," and a third from the workers for reform in the curricula of German schools.

The catalogue contains a history of the development of the house of Teubner, with particular mention of the two undertakings, the Encyclopedia of the mathematical sciences, and the publication of the works of Euler. About thirty books on mathematical subjects are mentioned as in press or in an advanced state of preparation.

THE following courses in mathematics are announced at the German universities during the winter semester, 1912–1913:

UNIVERSITY OF BERLIN.—By Professor H. A. SCHWARZ: Differential calculus, four hours; Elliptic functions, four hours; Certain problems in maxima and minima treated by elementary geometry, two hours; Exercises in differential calculus, four hours; Colloquium, two hours; Seminar, two hours.— By Professor G. FROBENIUS: Algebra, four hours; Seminar, two hours.—By Professor F. SCHOTTKY: General theory of analytic functions, four hours; Potential function, four hours; Seminar, two hours.—By Professor G. HETTNER: Definite integrals, two hours.—By Professor J. KNOBLAUCH: Mathematical problems, four hours; Twisted curves and surfaces, four hours; Mathematical exercises, one hour.—By Professor R. LEHMANN-FILHÉS: Analytic geometry, four hours.— By Dr. K. KNOPP: Theory of numbers, four hours; Advanced function theory, four hours; Chapters from the theory of infinite series, one hour.

UNIVERSITY OF BRESLAU.—By Professor R. STURM: Plane analytic geometry, three hours; Theory of transformations, I, three hours.—By Professor A. KNESER: Exercises from the mathematico-physical seminar, two hours; Integral calculus, four hours; Theory of probability, two hours.—By Professor E. SCHMIDT: Theory of analytic functions, four hours; Theory of real functions, II, two hours.—By Dr. W. SCHNEE: Algebra, II, four hours; Exercises in mathematics, three hours.

UNIVERSITY OF ERLANGEN.—By Professor M. NOETHER: Differential and integral calculus, I, four hours; Theory of functions, four hours; Seminar.—By Professor E. FISCHER: Analytic geometry, I, four hours; Differential equations, three hours; Selected topics from advanced algebra, I, one hour.

UNIVERSITY OF GIESSEN.—By Professor L. SCHLESINGER: Theory of functions, three hours; Theory of numbers, two hours; Differential and integral calculus, four hours; with exercises, one hour; Seminar, one hour.—By Professor H. GRASSMANN: Plane analytic projective geometry, four hours; Descriptive geometry, II, five hours; Seminar, exercises on projective geometry, one hour.

UNIVERSITY OF GÖTTINGEN.—By Professor F. KLEIN: Development of mathematics during the nineteenth century,

four hours; Seminar, two hours.—By Professor D. HILBERT: Theory of partial differential equations, two hours; Mathematical foundations of physics, two hours; Axioms of physics, Seminar, two hours.—By Professor C. RUNGE: Numerical calculation, with exercises, six hours; Selected chapters of mechanics, two hours.—By Professor E. LANDAU: Infinite series, four hours; Seminar, two hours.—By Professor F. BERNSTEIN: Mathematics of insurance, two hours.—By Dr. O. TOEPLITZ: Differential and integral calculus, II, four hours; Theory of invariants, two hours.—By Dr. H. WEYL: Theory of functions, four hours; Integral equations, three hours.—By Dr. T. v. KÁRMÁN: Mechanics, I, four hours.— By Dr. R. SCHIMMACK: Mathematical didactics, two hours.— By Dr. H. v. SANDEN: Descriptive geometry, four hours; with exercises, four hours.—By Dr. G. V. RÜMELIN: Introduction to the mathematical treatment of the natural sciences, three hours.—By Dr. R. COURANT: Determinants, four hours; Exercises in the theory of functions, two hours; Applications of determinants to geometry, four hours.—By Dr. P. HERTZ: Kinetic theory of gases, two hours; Elementary theory of numbers, four hours.

UNIVERSITY OF GREIFSWALD.—By Professor F. ENGEL: Differential geometry, four hours; Partial differential equations, four hours; Transformation groups, two hours; Seminar, two hours.—By Professor K. T. VAHLEN: Algebra, four hours; Statistics with emphasis on graphical methods, two hours; with exercises on graphical methods, two hours.—By Dr. W. BLASCHKE: Analytic geometry, five hours; Calculus of variations, two hours.

UNIVERSITY OF JENA.—By Professor J. THOMAE: Ordinary differential equations, five hours.—By Professor L. HAUSSNER: Twisted curves and surfaces, four hours; Differential and integral calculus, with exercises, II, five hours; Analytic geometry of space, four hours; Proseminar, analytic geometry of space, two hours; Seminar, one hour.—By Professor G. FREGE: Analytic mechanics, four hours.—By Dr. M. WINKELMANN: Descriptive geometry, four hours; Exercises in descriptive geometry, two hours; Exercises in ordinary differential equations, one hour.

UNIVERSITY OF KIEL.—By Professor L. POCHHAMMER:

Differential equations with one independent variable, four hours; Analytic geometry of space, four hours; Seminar, one hour.—By Professor G. LANDSBERG: Theory of numbers, four hours; Calculus of variations, four hours; Seminar, one hour.—By Professor M. DEHN: Integral calculus, four hours; Projective geometry, three hours; Exercises in applied mathematics, one hour.—By Dr. R. NEUENDORFF: Descriptive geometry, II, three hours.

UNIVERSITY OF MÜNSTER.—By Professor W. KILLING: Analytic geometry, II, four hours; Theory and applications of elliptic functions, two hours; Determinants and elementary algebra, two hours; Exercises in analytic geometry, one hour; Seminar, two hours.—By Professor R. v. LILIENTHAL: Differential and integral calculus, II, four hours; Theory of curvature of curves and surfaces, four hours; Political arithmetic and insurance, two hours; Exercises in integral calculus, one hour; Seminar, two hours.—By Dr. A. TIMPE: Synthetic geometry, three hours.

UNIVERSITY OF TÜBINGEN.—By A. v. BRILL: Introduction to higher mathematics, four hours; The mechanics of Hertz, three hours; Seminar, two hours.—By Professor L. MAURER: Elementary analysis, four hours; Integral equations, three hours; Seminar, two hours.—By Professor O. PERRON: Integral calculus, four hours; Theory of linear differential equations, three hours; Seminar, integral calculus, one hour.

UNIVERSITY OF PARIS. By Professor G. DARBOUX: Infinitesimal geometry and applications, two hours.—By Professor E. GOURSAT: Differential and integral calculus, elements of the theory of analytic functions, two hours.—By Professor E. BOREL: Functions of a large number of variables, one hour. —By Professor P. APPELL and M. C. GUICHARD: General laws of equilibrium and motion, two hours.—By Professor J. BOUSSINESQ: Mechanical properties of fluids and special types of fluid motion, two hours.—By Professor G. KOENIGS: Dynamics of continuous media from the point of view of the applications, two hours.—By MM. VESSIOT and MONTEL: Cours de mathématiques préparatoires, two hours.—By M. A. CAHEN: Fermat's last theorem, two hours.

Conferences will be conducted by MM. Lebesgue, Guichard, Vessiot, Montel, and Servant.

In the Ecole Normale courses in "mathematics" are given by Professors BOREL, CARTAN, and MM. VESSIOT and LEBESGUE.

In the second semester the following courses are announced: By Professor E. PICARD: Recent researches in the theory of analytic functions and in particular its relation to integral equations.—By Professor E. GOURSAT: Ordinary and partial differential equations.—By Professor P. APPELL: General laws of motion of systems, analytic mechanics, hydrostatics and hydrodynamics.—By Professor J. BOUSSINESQ: Waves of oscillation, emersion, and impulsion, sonorous waves.—By M. VESSIOT: Analysis and mechanics.—By M. A. CAHEN: Fermat's last theorem.

THE Academy dei Lincei at Rome has received from Dr. GINO MODIGLIANI, the sum of 4000*l*, to be used in the publication of the works of Leonardo da Vinci.

PROFESSOR G. LORIA, of the University of Genoa, and Professor R. MARCOLONGO, of the University of Naples, have been elected corresponding members of the Academy dei Lincei at Rome.

AT the United States Naval Academy, Professor H. E. SMITH has been appointed head of the department of mathematics and mechanics. The former ranking members of the department, Professors S. J. BROWN and H. M. PAUL, have been assigned to duty elsewhere.

AT the Georgia School of Technology, Professor FLOYD FIELD, head of the department of mathematics, has been granted a year's leave of absence for study at Harvard University. Mr. W. V. SKILES has been appointed associate professor of mathematics and acting head of the department during Professor Field's absence. Mr. L. W. MURPHY has been appointed assistant professor of mathematics.

PROFESSOR S. L. BOOTHROYD, of Cornell University, has been appointed associate professor of mathematics and astronomy at the University of Washington.

PROFESSOR G. P. PAINE, of the University of Minnesota, has been appointed assistant professor of mathematics at Middlebury College.

AT Yale University Dr. W. A. WILSON has been promoted to an assistant professorship of mathematics.

AT the University of Wisconsin Dr. ARNOLD DRESDEN has been promoted to an assistant professorship of mathematics.

AT the University of North Dakota Mr. R. R. HITCHCOCK has been promoted to an assistant professorship of mathematics.

PROFESSOR W. P. RUSSELL, of Pomona College, has been promoted to an associate professorship of mathematics.

PROFESSOR C. S. ATCHINSON, of Williams College, has been appointed professor of pure mathematics in Washington and Jefferson College.

DR. S. A. URNER, of Miami University, has been promoted to an assistant professorship of mathematics.

AT Hamilton College Professor W. M. CARRUTH has been promoted to an associate professorship of mathematics.

DR. S. D. KILLAM has been appointed instructor in mathematics in the University of Rochester.

MR. CORNELIUS GOUWENS has been appointed instructor in mathematics at the University of Iowa.

PROFESSOR R. E. ALLARDICE, of Stanford University, has been granted leave of absence for the present academic year.

DR. G. E. WAHLIN, of the University of Illinois, has been granted leave of absence during the entire academic year and will study in Europe.

PROFESSOR C. H. BECKETT, of Purdue University, has resigned to engage in actuarial work.

THE death is announced of LUCIEN LÉVY, past president of the mathematical society of France, at the age of 59 years.

PROFESSOR F. KOTTER, of the Berlin technical high school, died August 17, at the age of sixty-one years.