

(1862 and 1885) of Stokes and Glazebrook, and the later papers alluded to before, are the natural sources of information for those who wish to go into these matters.

For advanced students in colleges and all who wish to acquire a thorough knowledge of the existing state of the undulatory theory of light, we recommend this admirable treatise. The type and illustrations are also models of clearness and elegance and reflect credit upon the publishers as well as the author.

JOHN E. DAVIES.

UNIVERSITY OF WISCONSIN,
Madison, October 12, 1891.

NOTES.

A REGULAR meeting of the NEW YORK MATHEMATICAL SOCIETY was held Saturday afternoon, November 7, at half-past three o'clock, the vice-president in the chair. The following persons having been duly nominated, and being recommended by the Council, were elected to membership: Professor Simon Newcomb, Navy Department and Johns Hopkins University; Dr. Oskar Bolza, Clark University; Mr. Charles Riborg Mann, Columbia College; Professor Ludovic Estes, University of North Dakota; Mr. Herbert Armistead Sayre, Montgomery, Alabama; Professor James Harrington Boyd, Macalester College; Dr. Asaph Hall, Jr., U. S. Naval Observatory; Dr. Percy F. Smith, Yale University; Mr. Edwin H. Lockwood, Yale University; Professor Robert Judson Aley, Indiana University; Professor Joseph V. Collins, Miami University; Dr. Charles H. Chapman, Johns Hopkins University; Professor Albert Munroe Sawin, University of Wyoming; Mr. Frank Gilman, Lowell, Massachusetts; Professor Henry Parker Manning, Brown University; Mr. Charles S. Peirce, Milford, Pennsylvania.

Mr. Charles P. Steinmetz read an original paper entitled "On the curves which are self-reciprocal in a linear nul-system, and their configurations in space."

Dr. Edward L. Stabler made some remarks upon the theory of errors which are equally probable between given limits.

THE *nul-system* in space, which formed the subject of Mr. Steinmetz's paper, is a one-to-one correspondence between points and planes such that any point lies in its conjugate plane, and conversely. A linear nul-system is one in which all the planes conjugate to the points of any straight line

intersect one another in a second straight line, so that there exists a one-to-one correspondence between the lines in space.

T. S. F.

THE 64th meeting of the *Gesellschaft deutscher Naturforscher und Ärzte* (a German association corresponding to the American Association for the Advancement of Science) was held this year at Halle a. S., September 21 to 25. If the list of papers announced in advance as to be read in the different sections can be taken as an indication of what was actually done, it appears that the section for mathematics and astronomy is by far the strongest of all sections, not only numerically—25 papers, the next in order being the section of physics with 13 papers, then the section for instruments of precision (*Instrumentenkunde*) with 8 papers, etc.—but in particular considering the weight of the names represented. It is worthy of notice that astronomy has hardly any share in this programme, the subjects belonging almost exclusively to pure higher mathematics. The association has a special section (only recently organized) for elementary mathematics and natural sciences and the allied educational questions. Professor Georg Cantor, of the University of Halle, was president of the section of mathematics and astronomy; Dr. H. Wiener, of the same university, was secretary.

The following is a list of the papers announced to be read in this section:

L. Kronecker of Berlin, Opening address; K. Neumann of Leipzig, On a question in electrodynamics; L. Koenigsberger of Heidelberg, On the theory of systems of partial differential equations; F. Klein of Göttingen, Account of recent English investigations in mechanics; F. Meyer of Clausthal, Review of the present state of the theory of invariants; M. Noether of Erlangen, The fundamental proposition on the intersection of three surfaces; Rohn of Dresden, On rational twisted quartics; E. Papperitz of Dresden, The general system of the mathematical sciences; Worpitzky of Berlin, On the axioms of geometry; H. Wiener of Halle, On the foundations and the system of geometry; F. Kraft of Zürich, The meaning and value of Grassmann's *Ausdehnungslehre* for the whole domain of mathematics and mechanics; V. Eberhard of Königsberg, Elements of a systematic exposition of the forms of polyhedra; F. Müller of Berlin, On literary enterprises adapted to facilitate the study of mathematics; A. Pringsheim of Munich (subject not announced); Finsterwalder of Munich, The images in dioptric systems of larger aperture and larger field of vision; W. Dyck of Munich (subject not announced); H. Schubert of

Hamburg, On a question in enumerative (*abzählende*) geometry; M. Simon of Strasburg, On a question in absolute geometry; C. Reuschle of Stuttgart, A fundamental system of identities of the algebraic functions; R. Mehmke of Darmstadt, Description of mechanisms for the mechanical solution of equations; Hilbert of Königsberg, On complete (*volle*) systems of invariants; Stäckel, Wangerin, G. Cantor, of Halle (subjects not announced).

A more detailed account of the meeting may be given later.

ON October 23 the Mathematical Society of the University of Michigan held its first meeting this fall. Professor F. C. Waguer read a paper on the mathematical principles of thermodynamics. The society was founded in November, 1890, and has held seven meetings in the course of the last academic year. Professor W. W. Beman is president; Dr. F. N. Cole is secretary.

A. Z.

At the meeting of the National Academy of Sciences held at Columbia College, November 10 to 12, the following papers of a mathematical nature were read: Certain new methods and results in optics, by Professor Charles S. Hastings; New pendulum apparatus, by Professor T. C. Mendenhall; Astronomical methods of determining the curvature of space, by Professor C. S. Peirce; Variation of latitude, by Professor S. C. Chandler; Color system, by Professor O. N. Rood; Reduction of Rutherford's photographs, by Professor J. K. Rees; Measurement of Jupiter's satellites by interference, by Professor A. A. Michelson.

Professor Hastings's paper contained some new and very simple demonstrations of optical formulæ already known, as well as certain important formulæ altogether new, including a general expression for magnifying power applicable to *both* telescopes and microscopes. Professor Peirce presented astronomical evidence tending to show that space possesses a negative curvature, and called attention to various methods of conducting an investigation of this property of space. Professor Chandler exhibited curves showing that the recently discovered variation of latitude could be made to explain certain hitherto unaccountable discordances in older observations. His paper was followed by considerable discussion among the astronomers present; Professors Young, E. C. Pickering, C. S. Peirce, Abbe, and Dr. Gould taking part. The chief question debated was whether the variation has a *terrestrial* or *celestial* origin. The investigations are being published in the *Astronomical Journal*. Professor Michelson described his recent measurements of Jupiter's satellites at the Lick Observatory, and thought that we may hope to measure the angular

diameters of some of the brighter stars, if they be as great as the hundredth part of a second of arc. His paper was perhaps the most important one of the session. In it was presented a new method of measuring the angular diameters of luminous discs by means of the interference phenomena produced by them. The experiments made at the Lick Observatory have been described in the *Publications of the Astronomical Society of the Pacific*. The 12-inch telescope was used, but a telescope is by no means indispensable for these observations, the chief requisite being a very favorable condition of atmosphere. It is to be hoped that these very promising researches will be continued.

H. J.

THE series of lectures given last winter at Johns Hopkins University to teachers and those intending to become teachers was so successful that a similar series is to be given this winter. Among the lectures promised we note one on the teaching of mathematics by Professor Simon Newcomb.

La Nature announces the death of Édouard Lucas, Professor of Mathematics at the Lycée Saint-Louis. His death was due to injuries received from a mishap at Marseilles during the meeting of the French Association for the Advancement of Science, at which he presided over the section of mathematics. He was the author of many papers, but was most widely known through his *Récréations Mathématiques*. The second volume of his more recent work *Théorie des Nombres* is still in press.

IN an article entitled "Twelve *versus* Ten," which appears in the November number of the *Educational Review*, Professor W.B. Smith strongly advocates duodenary numeration.

JOHN WILEY & SONS have in preparation a new work on "The Theory of Errors and Method of Least Squares," by Professor W. Woolsey Johnson.

T. S. F.