SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, JANUARY 29, 1904.

CONTENTS:

The American Association for the Advancement of Science:—
Section A, Mathematics and Astronomy: PROFESSOR LAENAS GIFFORD WELD 161
Section G, Botany: PROFESSOR FRANCIS E. LLOYD 165
Geography in the United States, II.: PROFESSOR W. M. DAVIS 178
Karl Alfred von Zittel: PROFESSOR HENRY FAIRFIELD OSBORN 186
Scientific Books:—
The Moth Book: DR. L. O. HOWARD. *Verworn's Allgemeine Physiologie:* PROFESSOR FREDERIC S. LEE 188
Scientific Journals and Articles 190
Societies and Academies:—
The Academy of Science and Art of Pittsburg: FREDERIC S. WEBSTER. *Wisconsin Academy of Sciences, Arts and Letters:* E. B. SKINNER. *Northeastern Section of the American Chemical Society:* ARTHUR M. COMEY 191
Discussion and Correspondence:—
Convocation Week: PROFESSOR E. L. NICHOLS, PROFESSOR W. LE CONTE STEVENS, PROFESSOR J. S. KINGSLEY. *The Scintillations of Radium:* PROFESSOR R. W. WOOD 192
Special Articles:—
The Occurrence of Zinc in Certain Invertebrates: HAROLD C. BRADLEY 196
Atmospheric Nitrogen for Fertilizing Purposes 197
Missouri Lead and Zinc Regions visited by the Geological Society of America: PROFESSOR A. R. CROOK 197
Scientific Notes and News 198
University and Educational News 200

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.
SECTION A, MATHEMATICS AND ASTRONOMY.

Vice-President—Otto H. Tittmann, Superintendent U. S. Coast and Geodetic Survey, Washington, D. C.

Secretary—Professor Laenas G. Weld, University of Iowa, Iowa City, Iowa.

Member of Council—Professor Ormond Stone.

Sectional Committee—Dr. G. B. Halsted, Vice-President, 1903; President C. S. Howe, Secretary, 1903; Superintendent O. H. Tittmann, Vice-President, 1904; Professor L. G. Weld, Secretary, 1904–1908; Professor W. W. Beman, one year; Dr. J. A. Brashear, two years; Professor J. R. Eastman, three years; Professor Ormond Stone, four years; Professor E. B. Frost, five years.

General Committee—Mr. Philip Fox.

Professor Alexander Ziwet, of the University of Michigan, was elected vice-president for the next meeting.

The Chicago Section of the American Mathematical Society and the Astronomical and Astrophysical Society of America met in affiliation with Section A. The papers presented before these affiliated societies will be noticed elsewhere. Those read before Section A were as follows:

A New Treatment of Volume: Professor GEORGE BRUCE HALSTED, Kenyon College, Gambier, Ohio.

In September, 1902, Poincaré wrote in his review of Hilbert's 'Grundlagen der Geometrie': "The fourth book treats of the measurements of plane areas. If this measurement can be easily established without the aid of the principle of Archimedes, it is because two equivalent polygons can either be decomposed into triangles in such a way that the component triangles of the one and those of the other are equal each to each, or else can be regarded as the difference of polygons capable of this mode of decomposition. But we must observe that an analogous condition does not seem to exist in the case of two equivalent polyhedrons; so that it becomes a question whether or not we can determine the volume of the pyramid, for example, without an appeal more or less disguised to the infinitesimal calculus. It is, therefore, not certain that we can dispense with the axiom of Archimedes in the measurement of volumes. Moreover, Professor Hilbert has not attempted it.''

Professor Halsted, in the paper in question, has attacked the problem in the following manner:

The product of an altitude of a tetrahedron by the area of its base is the same whichever of the four faces may be chosen as base. This product is, therefore, a 'natural invariant' of the tetrahedron and may be designated as its volume, except that in order to adjust the conception to our ordinary numerical scale the factor *one third* is arbitrarily introduced. After defining a transversal partition of a tetrahedron as one made by a plane through an edge and a point of the opposite edge, it was shown that, however this solid be cut by a plane, the partition can be obtained as a result of successive transversal partitions, using not more than two other planes.

The above being explained, it was shown that the volume of any tetrahedron is equal to the sum of the volumes of all tetrahedrons which result from any set of transversal partitions. This need not be assumed as self-evident, but may be demonstrated as a necessary consequence of the so-called 'betweenness' assumption with reference to three co-straight points. Similar principles were deduced for polyhedrons in general, and by their use a general theory of volume was built up without reference to the ordinary notions of ratio and commensurability. The same method of treatment may be applied to figures in hyperspace of any order.

Lines on the Pseudosphere and the Syntractrix of Revolution: E. L. HANCOCK, Purdue University, Lafayette, Indiana.

The lines of the pseudosphere are reviewed and those of the syntractrix of revolution studied. The latter surface S_1 is defined as the surface generated by the revolution of the curve C_1 about its asymptote; C_1 being determined by laying off a constant distance d on the tangents of the tractrix.

The geodesic, asymptotic and loxodromic lines on S_1 are worked out and studied by classifying the surfaces according as

$$d \gtreqless 2c,$$

c being the constant of the tractrix. When $d \geqq 2c$ it happens that the geodesic lines on S_1 are all real; while for $d < 2c$ they are real or imaginary according as

$$\kappa^2 \lessgtr \left| \frac{c^2 d^2}{d^2 - 4cd} \right|,$$

κ being a constant of integration.

The loxodromic lines of the syntractrix of revolution are represented in the plane by the same system of straight lines as represent the loxodromic lines of the pseudosphere.

The Rotation Period of the Planet Saturn: Professor G. W. HOUGH, Director of Dearborn Observatory, Evanston, Ills.

In 1877 Professor Asaph Hall, then at the U. S. Naval Observatory, observed a spot near to Saturn's equator and by its means determined the period of the planet's rotation. From that time on, until the recent opposition, no well-defined spot has been visible. On June 23, 1903, however, Professor E. E. Barnard, of the

Yerkes Observatory, noted a large and distinct spot in Kronocentric latitude 36°.5. This was observed micrometrically on June 27 and July 13.

Acting upon the request of the author, micrometric observations of spots on Saturn were made by Professor S. W. Burnham with the 40-inch Yerkes equatorial. Measurements were secured on July 29 and August 15. From these data the 'mean' rotation period deduced was $10^h\,38^m\,27^s$; but the observations showed the period to be variable. The value $10^h\,38^m\,18^s + n \times 0^s.1856$ was found to satisfy all the observations with a mean error of $\pm\,0^m.8$. In the formula n is the number of rotations of the planet counting from the epoch of the discussion, June 23, 1903.

An Extension of the Group Concept: Dr. EDWARD KASNER, Columbia University, New York.
Read by title.

Facilities for Astronomical Photography in Southern California: E. L. LARKIN, Director of Lowe Observatory.

Attention was called to the fact that, from May 1 to November 1, the observer upon Echo Mountain enjoys an almost unbroken succession of cloudless days and nights. During the greater part of this season the air becomes remarkably steady shortly after sunset; so much so that the rings of Saturn may be seen rising as a minute but sharply defined arch over the crest of the neighboring mountain ridge. In the rainy season, after a shower, the air is of such transparency that mountains distant a hundred miles or more may be seen with clearness and distinctness.

In view of these conditions Mr. Larkin urged the establishment of an observatory equipped for astro-photography upon the summit of Echo Mountain. Attention was called to the faint nebulous light forming the background of large regions of the sky as observed from this station. Some interesting views of Lowe Observatory and its surroundings were projected upon the screen, together with a number of the famous Lick Observatory photographs.

Coincident Variations: LUCINUS S. MCCOY, Whitten, Iowa.
Read by title.

On the Generalization and Extension of Sylow's Theorem: Dr. G. A. MILLER, Stanford University, California.

Dr. Miller's paper, which will shortly be printed in full, is in abstract as follows:

Let p^α be the highest power of p which divides the order of a group (G), and suppose that a subgroup (P_α) of order p^α contains only one subgroup (P_β) of order p^β and of a particular type. It is proved that the number of subgroups of G which are of the same type as P_β is of the form $1 + kp$, and that all of these subgroups form a single conjugate set. Hence the order of G is of the form $p^\beta h_1(1 + kp)$ where $p^\beta h_1$ is the order of the largest subgroup of G which transforms P_β into itself. By letting $\beta = \alpha$ we have Sylow's theorem. When $\beta = \alpha$ the factor h_1 is not divisible by p while it is divisible by p for all other values of β. Some simplifications of the proof of Frobenius's extension of Sylow's theorem are also considered.

The Supporting and Counter-weighting of the Principal Axes of Large Telescopes: C. D. PERRINE, Lick Observatory, Mt. Hamilton, California.

In large telescopes it is necessary to reduce the friction of the axes in their bearings. This has usually been done by a system of friction wheels held against the axis by weights and levers.

Experience with the roller bearings used in the driving-clock for the new mounting of the Crossley reflector suggested the same principle as being suitable for the axes of large telescopes. These bearings are very simple in construction and consist of a ring of hardened steel rollers around the axis, in the bearing. The rollers fit closely about the axis and, therefore, do not require any frame to hold them in their relative positions. There is no looseness and the axis revolves with perfect accuracy, yet easily.

Such bearings would be fully as efficient in the case of a large overhang of the polar-axis as in the ordinary form of mounting. Where the ends of the polar axis are supported on separate piers the bearings can be made self-aligning.

A Linkage for Describing the Conic Sections by Continuous M on: J. J. QUINN, Warren, Pa.

This linkage is the material embodiment of the facts set forth in the following theorem:

If one vertex of a movable pivoted rhombus be fixed in position, while the opposite vertex is constrained to move in the arc of a circle, the locus of the intersection of a diagonal (produced) through the other two vertices, with the radius (produced) of the circle in which the vertex moves is a conic.

If the fixed vertex is in the diameter of the circle, and the directing radius finite, the locus is an ellipse. If the directing radius is infinite and the fixed vertex in the diameter, the locus is a parabola. If the directing radius is finite, and the fixed vertex is in the diameter produced, the locus is a hyperbola. Modifications of the essential features of this linkage give rise to many interesting corollaries involving the geometric construction of the conics, their tangents and normals.

Circles Represented by $\mu^3P+L\mu^2Q+M\mu R+NS=0$*:* T. R. RUNNING, Ann Arbor, Michigan.

In the equation discussed μ is a variable parameter; L, M and N are constants; P, Q, R and S represent circles. The equation itself represents circles for all values of the parameter. Three circles of the system pass through each point of the plane. The locus of the centers of the system is a cubic having eight arbitrary constants.

There will be a circle orthogonal to the system if any one of the circles P, Q, R, S can be derived linearly from the other three. There are six point circles in the system, all lying upon the locus of the centers. Four circles of the system are tangent to any one. Eight pairs of tangent circles have a common linear relation connecting their parameters.

The envelope of the system is

$$18\,LMNPQRS-27\,N^2P^2S^2+L^2M^2Q^2R^2 -4(L^3NQ^3S+M^3PR^3)=$$

which may be written

$$B^2=4AC,$$

where

$$A=L^2Q^2-3PMR,\quad C=M^2R^2-LQNS,$$
$$B=LMQR-9PNS.$$

It is shown that this is the envelope of

$$\mu^2A+\mu B+C=0,$$

A, B, C being bicircular quartics which are themselves envelopes of systems derived from the original circles.

The envelope of the radical axes of a particular circle and other circles of the system is a conic. This conic may be said to correspond to the particular circle, and there is such a conic corresponding to every circle of the system. The system of circles represented by

$$\mu^3P+L\mu^2Q+M\mu R+NS=0$$

is called the primary system, and the system of conics corresponding to it in the manner above explained, the secondary system. It is shown that the equation of a conic of the secondary system is of the fourth degree with respect to the parameter and that, therefore, four conics of the secondary system pass through any particular point in the plane.

The equation of the radical axis of two circles, μ and μ', of the system is

$$y=\frac{F}{G}x+\frac{H}{G},$$

F and H being of the fourth degree in μ and μ' and G of the third degree. It thus appears that there are sixteen sets of values of μ and μ' for which this equation represents the same radical axis; that is, there are sixteen pairs of circles having the same radical axis. Moreover, to these thirty-two circles there correspond thirty-two conics of the secondary system, all of which are tangent to the same radical axis.

The paper includes, by way of introduction, a brief discussion of the equation

$$\mu^2P+L\mu Q+MR=0.$$

A New Type of Transit-Room Shutter: Professor DAVID TODD, Amherst, Massachusetts.

The type of shutter here described is that used to cover the two transit slits of the new observatory of Amherst College. These slits have a clear opening of 100° each way from the zenith and are three and one half feet in width. Each shutter is twenty-one feet long and sixteen feet high. It is made of structural steel with two vertical members and one truss member across the roof. Its weight is about three thousand pounds.

The entire shutter moves as a unit upon ball-bearing rollers underneath the vertical members. These rollers travel upon rails lying east and west along the north and south walls of the building. The two ends of the shutter are made to travel in unison by means of rack and pinions with sprocket wheels and link-belt chain.

The roof-member travels ten inches above the roof of the transit room, thus clearing all ordinary depths of snow. Only the bottom of this member is covered in, the structural elements of its top and sides being left exposed as in bridge work. Wind thrust is thereby minimized.

The entire shutter opens or closes full width in four seconds, by eight turns of a hand wheel. A small shaft lock holds it firmly in either position.

LAENAS GIFFORD WELD,
Secretary.

SECTION G, BOTANY.

SECTION G at the St. Louis meeting was organized, under the chairmanship of Professor T. H. Macbride, on December 28, 1903. The other officers were as follows:

Secretary—F. E. Lloyd.
Councillor—Wm. Trelease.
Sectional Committee—T. H. Macbride, vice-president, 1904; F. E. Lloyd, secretary, 1904–1908; F. V. Coville, vice-president, 1903; C. J. Chamberlain, secretary, 1903; W. A. Kellerman (one year), F. S. Earle (two years), C. E. Bessey (three years), W. T. Beal (four years), F. E. Clements (five years).
Member to General Committee—C. L. Shear.

Meetings of the section for the reading of papers and for other business were held on December 28, 29, 30, 31 and January 1. The Mycological Society and the Botanists of the Central States met conjointly with the section.

A committee consisting of Professor C. E. Bessey, Dr. B. T. Galloway and Professor C. MacMillan drew up a resolution strongly endorsing the efforts at present being made looking toward the passage of such laws by Congress as will provide for the perpetual preservation of the Calaveras Grove of Big Trees in California.

On Friday morning the section, together