also to serve in many ways the larger general public.

It is a peculiar pleasure to me to be present to-day at the dedication of the John Bell Scott Physical Laboratory. It is a beautiful building, a fit representative of the splendid science to which it is dedicated; a notable addition to the equipment of Wesleyan, testifying eloquently to the generosity and loyalty of the donors; a worthy memorial to the unselfish life of the noble young man after whom it is named. The good it will do in the future years is immeasurable.

Edward B. Rosa.
National Bureau of Standards.

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

Vice-President—Professor Alexander Ziwet, University of Michigan, Ann Arbor, Michigan.

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

Member of the Council—Professor J. R. Eastman.

Sectional Committee—Superintendent O. H. Tittmann, Vice-President, 1904; Professor Alexander Ziwet, Vice-President, 1905; Professor L. G. Weld, Secretary, 1904–1908; Dr. J. A. Brashear, one year; Professor J. R. Eastman, two years; Professor Ormond Stone, three years; Professor E. B. Frost, four years; Professor E. O. Lovett, five years.

Member of the General Committee—Professor G. B. Halsted.

Press Secretary—Professor J. F. Hayford.

Dr. W. S. Eichelberger, of the U. S. Naval Observatory, was elected vice-president for the next meeting.

The Astronomical and Astrophysical Society of America met in affiliation with Section A, the two organizations holding alternate sessions on December 28, 29 and 30.

The vice-presidential program was presented on the afternoon of Wednesday, December 28. In accordance with the recommendations of the Committee on the Policy of the Association this program was given a broader scope than heretofore and included the address of the retiring vice-president, Superintendent O. H. Tittmann, upon the subject 'The Present State of Geodesy,' and a paper by Professor Josiah Royce, of Harvard University, entitled 'Symmetrical and Unsymmetrical Relations in the Exact Sciences.' The former of these has been published in Science for January 13, and the latter will appear in an early number of the same journal.

The following papers were presented at the regular meetings of the section:

Synchronous Variations in Solar and Meteorological Phenomena: Mr. H. W. Clough, U. S. Weather Bureau, Washington, D. C.

The portion of the paper relating to meteorological phenomena is essentially an extension of Professor Brückner's researches on the 35-year cycle of variation in terrestrial climates. Definite epochs have been assigned for the variations of the several meteorological elements and the results of Brückner have been supplemented by investigations of various minor meteorological relations and the prices of grain. The probable value of the period length is found to be 36.2 years, instead of 34.8 years, Brückner having used in calculating the latter value an extra oscillation in the sixteenth century, which should be regarded as a secondary variation. Brückner traced the cycle as far back as 1000 A. D. by means of historical accounts of several winters. Comparison of the epochs in different latitudes discloses an apparent retardation in low latitudes. This may indicate that the influence efficient in producing these variations is experienced mainly in high latitudes. Periods of excessive precipitation follow by about five years those of deficient tem-

perature. These cold, wet periods are characterized by a more rapid atmospheric circulation and a lower average latitude of storm tracks. Investigation of grain prices in England from about 1265 shows variations in a cycle of 36 years, high prices corresponding with cold, wet periods.

Wolfer's epochs of maximum and minimum sunspots from 1610 show that the so-called 11-year period is a variable interval, ranging from 8 to 16 years. These varying intervals have a periodicity of about 36 years and it is found that periods during which the sunspot interval is at a minimum are characterized by maximum sunspot and auroral manifestations. This 36-year cycle in solar phenomena has been traced back to about 1000 A. D. by utilizing the 'probable maxima' of Fritz. The sun may, therefore, be regarded as a variable star, whose mean period of variation undergoes a cyclical variation in length.

Comparing the solar and meteorological epochs in the 36-year cycle from 1050 to 1900, the epochs of maximum solar activity, as evidenced by a decreased length of the sunspot period, are shown to precede the epochs of low terrestrial temperatures by from seven to ten years.

A long-period variation of about 300 years is shown by variations in solar spottedness, in the ratio $a : b$, and in the length of the 36-year cycle; the ratio $a : b$ and the length of the cycle decreasing with increasing solar activity. This cycle of 300 years is traced in solar variations during the past thousand years and is also apparent in meteorological variations, as shown by the records of the time of vintage of Dijon, France, since 1400.

Tables showing solar and meteorological epochs were exhibited.

Temperature Corrections of the Zenith Telescope Micrometer, Flower Astronomical Observatory: Professor C. L. DOOLITTLE, University of Pennsylvania.

Results from Observations of the Sun, Moon and Planets for 26 Years: Professor J. R. EASTMAN, Andover, N. H.

The only continuous and complete set of observations of the sun, moon and planets, in this country, was made at the Naval Observatory from January, 1866, to June 30, 1891. This work was continuous with the observations of the standard and miscellaneous stars, and most of the results were found to be affected by the same errors that modified the results for the stars, and also by errors peculiar to observations of bodies presenting in the telescope large disks, like those of the sun and the moon, smaller ones like those of major and minor planets. The errors pertaining to the stars were discussed in the introduction to the 'Second Washington Catalogue of Stars'; and more in detail in a paper read at the last Boston meeting of this association.

The second class of errors mentioned above was considered and it was shown that there is a high probability of the presence of peculiar errors in solar, lunar and planetary observations with all large instruments where measures are made of both coordinates.

Determination of the Solar Rotation Period from Flocculi Positions: Mr. PHILIP FOX, Yerkes Observatory, Williams Bay, Wis.

This determination is based upon measurements of flocculi positions on spectroheliograms obtained at the Kenwood Observatory during the spot-maximum of 1892–'93–'94. The method of measurement devised by Mr. Hale, that of projecting the plate upon a globe whose surface is ruled in degrees of longitude and latitude, proved to be accurate and rapid. Motions for proper orientation of the image upon the globe were provided. The results obtained from measurements of about 1,000 points have been grouped in zones 5 wide and are exhibited in the following table:

0 to 5	24.56 days.
5 to 10	24.79 "
10 to 15	25.03 "
15 to 20	25.26 "
20 to 25	25.45 "
25 to 30	25.99 "
30 to 35	25.31 "

Determination of all Non-divisible Groups of Order $p^m \cdot q$ which Contain an Abelian Subgroup of Order p^m and Type [1, 1, 1 ⋯ to m units]: Mr. O. E. Glenn, University of Pennsylvania, Philadelphia.

Burnside remarks, at the beginning of Chapter XV. of his 'Theory of Groups,' that the most general problem of finite group theory is the determination and analysis of all distinct types of groups whose order is a given integer. The author suggests as a more comprehensive problem the *generalization* of all types belonging to a given integer. In the paper is given a determination of the sets of defining relations which include as special cases all groups of order pq, p^2q, and a family of the known groups of order p^3q.

When q is a proper divisor of $p^m - 1$, G is defined by the relations

$$P_i^p = Q^q = 1, \quad P_iP_j = P_jP_i, \quad Q^{-1}P_kQ = P_{k+1} \quad (i=1, 2, \ldots, m;\ j=1, 2, \ldots, m;\ k=1, 2, \ldots, m-1.)$$

$$Q^{-1}P_mQ = P_1^{(-1)^{m-1}}P_2^{(-1)^{m-2}\Sigma(\lambda\lambda^p \ldots \lambda^{p^{m-2}})} \ldots P_{m-1}^{-\Sigma(\lambda\lambda^p)}P_m^{\Sigma(\lambda)},$$

λ being a mark of the $G \cdot F(p^m)$ and a primitive root in that field of the congruence

$$\lambda^q \equiv 1 (\mathrm{mod}\ p).$$

In case $p \equiv 1$ (mod. q) the group is defined by

$$P^{ip} = Q^q = 1,\ P_iP_j = P_jP_i,\ Q^{-1}P_iQ = P_i^{\alpha^{x_i}} (x_1 = 1),\quad \alpha^q \equiv 1 (\mathrm{mod.}\ p).$$

The first set of relations represents a single type. The number of types in the second set is given by

$$N = \frac{1}{m}\left[\sum_{\sigma=1}^{(m-1)(q-1)} P(0, 1, 2, \cdots, q-2)^{m-1}\sigma - \psi\right],$$

P being Cayley's form of the partition symbol and ψ a determinate function of m and q.

A Note on Groups of Order 2^m which Contain Self-conjugate Groups of Order 2^{m-2}: Dr. G. H. Hallett, University of Pennsylvania, Philadelphia.

In the list of groups of the character indicated above which is given in Burnside's 'Theory of Groups,' there are six types. There appears to be a simple type of group which is non-isomorphic to any one of these six groups. The object of the paper is to set up the defining relations of this type, viz.,

$$P^{2^{m-2}} = 1, \qquad Q^4 = P^{2^{m-3}}, \qquad Q^{-1}PQ = P^{-1}.$$

Biology and Mathematics: Professor G. B. Halsted, Kenyon College, Gambier, O.

In Professor Halsted's paper attention was called to certain analogies which have been assumed to exist between the mathematical doctrine of continuity and the evolution of new species through natural selection. He then proceeded to show that the analogy between mathematics and biology is much closer if we emphasize, on the one hand, the idea of discontinuity as it appears in modern mathematics and, on the other, those phases of the process of evolution supposed to be more readily explained by the theory of mutations.

The Path of the Shadow of a Plummet Bead: Professor Ellen Hayes, Wellesley College, Wellesley, Mass.

The equation to the path of the shadow of a plummet bead was derived, and discussed for various latitudes and for different seasons of the year.

The interest and value which this gnomon conic possesses as an observation exercise for beginners in elementary practical astronomy were made apparent.

The Computation of the Deflections of the Vertical due to the Topography Surrounding the Station: Professor J. F. HAYFORD, Coast and Geodetic Survey, Washington, D. C.

The computation of deflections of the vertical depending upon the topography surrounding a station is of fundamental importance in connection with new investigations of the figure of the earth. Such computations have been available in but few cases because of the difficulty of making them. The method now in use by the Coast and Geodetic Survey was fully shown. Such computations by this method have already been made at 250 astronomical stations in the United States, in each of which account is taken of the topography within a circle surrounding the station having a radius of more than 2,500 miles.

Extension of a Theorem due to Sylow: Professor G. A. MILLER, Stanford University, Cal.

Every group G of order p^m, p being any prime number, contains at least p invariant operators. This fundamental theorem, due to Sylow, is included in the following:

Every non-abelian group of order p^m contains at least p invariant commutator operators, and its commutator quotient group is always non-cyclic. The paper is devoted to a proof of this theorem and the following closely related theorems:

It is possible to construct a non-abelian group having any arbitrary abelian group as a commutator quotient group.

Every non-cyclic abelian group of order p^α is the commutator quotient group of some non-abelian group of order p^m.

On Inversions: Professor J. J. QUINN, Warren, Pa.

Mr. Quinn exhibited and explained a number of new linkages for describing the right line, in each of which the principle of inversion was applied.

On Systematic Errors in Determining Variations of Latitude: Mr. FRANK SCHLESINGER, Yerkes Observatory, Williams Bay, Wis.

Observations for the variation of latitude seem to be subject to certain systematic errors. In this paper two contemporaneous series made near Honolulu in 1891 and 1892 are discussed and compared. The method of separating the systematic errors common to both series from the accidental is indicated, the conclusion being that there is present some source of error common to both observers and therefore probably beyond their control. This result is shown to be independent of any assumption regarding the variation of latitude during the period under discussion.

Some Experiments on the Distortion of Photographic Films: Mr. FRANK SCHLESINGER, Yerkes Observatory, Williams Bay, Wis. Read by title.

Bibliography and Classification of Mathematical and Astronomical Literature at the Library of Congress: Mr. J. D. THOMPSON, Library of Congress, Washington, D. C.

Attention was called to the printed cards issued by the Library of Congress for books and pamphlets on mathematics and astronomy in its collection and it was explained how these may be used to great advantage in the special libraries of the mathematical departments of universities and of observatories. The classification scheme used at the Library of Congress was also explained. This paper will be printed by the Library of Congress.

On an Optical Method of Radial Adjustment of the Axes of the Trucks of a Large Observatory Dome: Professor DAVID TODD, Director Amherst College Observatory, Amherst, Mass.

The larger dome of the new observatory of Amherst College is mounted on fourteen

trucks, fitted with twin rings of double ball bearings of the Chapman type. The treads of the wheels are coned to the exact angle which will make their apexes all coincide with the point at the center of the plane of the circular trucks. Ease of revolution of the dome depends very largely upon the accuracy with which this adjustment is made and maintained. The necessary condition has been secured by attaching a small galvanometer mirror to the axis of each truck, and adjusting it normally. A theodolite mounted at the center of the dome then gave the reflections of its objective exactly centered on the cross wires, when the axis of the truck was brought to the proper direction.

An Exhibition of a New Form of Frame for Straight Line Mathematical Models: Professor C. A. Waldo, Purdue University, Lafayette, Ind.

A new form of thread model for ruled surfaces was exhibited by Professor Waldo, the frame for the model being conformed to the surface of a sphere, thus permitting location of the points of attachment of the threads with much greater ease than in the ordinary forms in which the limiting surface is discontinuous. The method of construction was also explained.

The Application of Mayer's Formula to the Determination of the Errors of the Equatorial: Professor L. G. Weld, State University of Iowa, Iowa City, Ia.

Let the polar axis of the equatorial be rigidly clamped with the telescope first to the east and then to the west of the pier and the transits of three stars observed in each of these positions of the instrument. The clock correction being assumed known, the errors of azimuth, level (of declination axis) and collimation (in right ascension) may be obtained for each position by the use of Mayer's formula. From the two sets of errors thus made known the mean azimuth error of the polar axis and the angle between this axis and the declination axis may be determined. The method is independent of the accuracy of the hour circle and may be used in correcting the setting of this circle upon the polar axis. When the hour circle is delicately graduated the data may also be used to determine the flexure of the declination axis.

Laenas Gifford Weld,
Secretary.

*ALBATROSS EXPEDITION TO THE EASTERN PACIFIC.**

The *Albatross*, under command of Lieut.-Commander L. M. Garrett, left San Francisco on the sixth of October and arrived at Panama on the twenty-second. I am fortunate in having as assistant for this trip Professor C. A. Kofoid, who has had great experience in studying the protozoa both in fresh water and at sea; he has been given charge of the collection of radiolarians and diatoms and of other minute pelagic organisms; and he will prepare a report on the results of that branch of the expedition. On the way along the coast Professor Kofoid took advantage of the opportunity for making surface hauls with the tow nets as well as vertical hauls, generally to a depth of 300 fathoms. A large amount of pelagic material was thus collected, not at a great distance from the coast, however. Off Mariato Point the *Albatross* made two hauls in the vicinity of the stations where in 1891 she found 'modern green sand,' in about 500 and 700 fathoms. It was interesting to find the green sand again, as the specimens collected in 1891 were lost in transit to Washington.

Immediately on reaching Panama the vessel was coaled and provisioned. On my

* Extract from a letter of Mr. Alexander Agassiz to Hon. George M. Bowers, U. S. Fish Commissioner, dated Lima, November 28, 1904.