

tell of him, which runs as follows: The first men had grown very wicked upon the earth, and, in punishment, suffered a great evil. The earth sent up from its bosom mighty masses of water. Heavy rains followed, the rivers swelled, and the sea overflowed the land, until all was covered with water, and all were destroyed; only Deucalion, of all mankind, remained alive. He had built a box or ark, and his family, as also pairs of all kinds of animals, entered into it. All sailed in the ark as long as the waters continued. So the Hellenes write of Deucalion. To this the inhabitants of the holy town add a very strange story; that in their land a great fissure opened in the earth, and this received all the water. Deucalion built altars after this happened, and by the opening built a temple to Here. I saw the opening. It is under the temple, and is very small. As a sign and remembrance of this story, they do as follows: Twice a year water is brought to the temple from the sea. Not alone do the priests bring this; out of all Syria and Arabia, India, and from beyond the Euphrates many go down to the sea, and all bring water. They pour it out in the temple, and it flows into the fissure, and the small opening receives a great quantity of water. And this ceremony, they say, Deucalion appointed in the temple in remembrance of the catastrophe and his rescue. A statue of Here is in the temple, and another god, which, although it is Zeus, they call by another name. Between the two stands a golden column. The Assyrians call it the sign, give it no special name, and cannot explain its origin or its form. Some refer it to Dionysus, others to Deucalion, others to Semiramis. There is on its top a golden dove. Therefore, it is said to represent Semiramis. Twice a year it is taken to the sea to bring water, as described above." There were similar Hydrophoria at Athens.

AMHERST COLLEGE.

B. K. EMERSON.

SECTION A—MATHEMATICS AND ASTRONOMY.

THE Vice-Presidential address before Section A was necessarily omitted, as illness in his family had prevented Prof. Story from preparing an address and from attending the meeting.

The vacancy in the chair was filled by the election, by the Association, of Prof. Alexander Macfarlane as Vice-President for the Section.

The following papers were presented before the Section, in number one less than were read at the Springfield meeting last year.

An Analog to De Moivre's Theorem in a Plane Point System: By E. W. HYDE.

Three points, e_0, e_1, e_2 , at the vertices of an equilateral triangle, are taken as a reference system, and an operator ω is assumed such that

$$\omega e_0 = e_1, \omega^2 e_0 = \omega e_1 = e_2, \omega^3 e_0 = \omega^2 e_1 = \omega e_2 = e_0.$$

Then the action of the general operator

$$x_0 + x_1 \omega + x_2 \omega^2,$$

in which $x_0, \dots, x_2$ are scalars, is discussed. The x 's are shown to be functions of a scalar n and an angle θ , designated as $K(n, \theta)$, such that

$$[K_0(n, \theta) + \omega K_1(n, \theta) + \omega^2 K_2(n, \theta)]^k \\ = K_0(n^k, k\theta) + \omega K_1(n^k, k\theta) + \omega^2 K_2(n^k, k\theta),$$

which is the analog of De Moivre's theorem. Addition-multiplication theorems for the K -functions are found, and a trigonometry of them developed.

Rational Scalene Triangles: By ARTEMUS MARTIN; read by the Secretary.

In this paper, which will appear in the *Mathematical Magazine*, formulæ are given for calculating the sides of rational triangles, with numerous illustrative examples.

New elements of the variable R Comæ, resulting from observation in July and August, 1896, and

Photometric Observations of Colored Stars: By HENRY M. PARKHURST.

The large discrepancies in photometric measures of colored stars led the author, who employs the method of extinctions in his photometer, to investigate the absorption of three principal colors—red, yellow and blue—by differently colored shades. The relative proportions of the three colors in the light of any particular star were measured, and corrections were deduced so that the effect of color was very largely overcome in observations by the method of extinctions.

Motion of the Great Red Spot and Equatorial Belt of the planet Jupiter from 1879 to 1896 :
By G. W. HOUGH.

From the comparison of his micrometrical measures (not mere drawings) of definite points upon the visible disk of the planet, the author obtained the (changeable) rate of rotation of the spot about the planet's rotation-axis, and he showed charts and diagrams of the motions of the belt both in latitude and longitude. No theory of the nature of the spot was advanced. The paper will be printed in the *Monthly Notices* of the Royal Astronomical Society.

On the direct application of a rational differential equation to a series of points whose coordinates represent observed physical properties : By ROBERT B. WARDER.

The theory for the speed of chemical action gives rise to differential equations, which are usually integrated before being applied to test a series of measurements. As the theoretical 'constant' often proves to be variable (showing that the assumed rational formula does not fully represent the processes of Nature), the character of the variations must be determined by one of several modes of calculation. The paper was mainly an inquiry as to the best methods of computing the required quantities. Three methods had been tried in an application to Lichty's determination of the speed of esterification of monochloroacetic

acid, and a further paper (offered with this for publication in the *Journal of Physical Chemistry*) was read before Section C.

A proposed fundamental integral-transcendent :
By JAMES McMAHON.

A large number of transcendent integrals are reducible to the fundamental form

$$\int \log \sec x \, dx.$$

which may be computed from a series and tabulated for different values of x . Let the function *ils* x (integral-log-secant x) be defined by the equation

$$\int_0^x \log \sec x \, dx = \text{ils } x,$$

then *ils* x may be computed and tabulated from the development

$$\frac{2}{\pi} \text{ils } \frac{\pi x}{2} = S_2 \frac{x^3}{3} + \frac{S_4}{2} \frac{x^5}{5} + \frac{S_6}{3} \frac{x^7}{7} + \frac{S_8}{4} \frac{x^9}{9} \dots$$

(where $S^n = \frac{1}{1^n} + \frac{1}{3^n} + \frac{1}{5^n} \dots \text{ad inf.}$)

which is convergent when $x < 1$, and can be used when the argument $\frac{\pi x}{2}$ lies between 0 and $\frac{\pi}{2}$,—a sufficient range, since *ils* $\frac{\pi}{2} = \infty$ and *ils* 0 = 0.

Numerous integrals were given which are expressible in terms of *ils* x , of which we illustrate by only three :

$$(1) \int_0^x \log \cos x \, dx = -\text{ils } x.$$

$$(3) \int_{\frac{\pi}{4}}^x \log \tan x \, dx = \text{ils} \left(\frac{\pi}{2} - x \right) + \text{ils } x - 2 \text{ils } \frac{\pi}{4}.$$

(This may be denoted by *ilt* x , integral-log-tan x .)

$$(11) \int_1^x \frac{\log x}{1+x^2} dx = \text{ilt} (\tan^{-1} y), \text{ etc.}$$

Analogous relations are found for hyperbolic functions. The paper will appear in the *Annals of Mathematics*.

On the Level of the Sun-Spots : By EDWIN B. FROST.

The correctness of the Wilsonian doctrine that Sun-spots are depressions in the solar

photosphere is examined, and evidence is brought forward from recent direct visual observations (Howlett, Sidgreaves, Spoerer), from the rate of solar rotation deduced from faculæ, spots, and surface (Dunér), and from the thermal absorption over spots, to support the view that spots may be masses of absorbing gases above rather than below the photosphere. The paper will be published in the *Astrophysical Journal*.

Sedenions: By JAMES B. SHAW; presented in outline by Prof. E. W. Hyde.

If q be any quaternion, Φ the operator on q such that if

$$\begin{aligned} q &= w + xi + yj + zk, \\ \Phi q &= (a^I w + b^I x + c^I y + d^I z) \\ &\quad + (a^{II} w + b^{II} x + c^{II} y + d^{II} z) i \\ &\quad + (a^{III} w + b^{III} x + c^{III} y + d^{III} z) j \\ &\quad + (a^{IV} w + b^{IV} x + c^{IV} y + d^{IV} z) k. \end{aligned}$$

Φ is called a *Sedenion*. The paper (offered for publication in the *Bulletin of the American Mathematical Society*) is a development of the elementary formulæ of *Sedenions* considered as an algebra of sixteen units. These formulæ are developed by the aid of Quaternions.

On the Distribution and the Secular Variation of Terrestrial Magnetism, No. IV: On the Component Fields of the Earth's Magnetism: By L. A. BAUER.

This paper, to appear in *Terrestrial Magnetism*, continues the researches hitherto published by the author, and is an attempt to resolve the prevailing magnetic field of the earth into its components. The paper was illustrated by maps and diagrams.

Determination of the Weights of Observations: By J. R. EASTMAN.

A brief account was given of a method of determining the weights to be used in combining the results of observations made in a series of years with the same instrument (meridian circle). The results also showed the futility of excessive repetition of an observation with a view to increased accuracy.

On the Composition of Simultaneous and Successive Vectors: By ALEXANDER MACFARLANE.

Vector Algebra is commonly founded partly on physical ideas, partly on arbitrary formal laws. The author prefers to give it a purely geometrical or physical basis. The sum of simultaneous vectors is commutative, because they have no real order; the sum of successive vectors is not commutative, because they have a real order. The square of a sum of successive vectors differs from the square of a sum of simultaneous vectors by a set of terms depending on the order of the succession. This was illustrated by the generalized form of the Exponential Theorem for space.

All the papers on the program having been read, at the conclusion of the session on Wednesday afternoon, August 26th, Section A adjourned.

EDWIN B. FROST,

DARTMOUTH COLLEGE.

Secretary.

SECTION B—PHYSICS.

THE address of the Vice-President, Carl Leo Mees, upon *Electrolysis and some Outstanding Problems in Molecular Dynamics*, will be printed in this JOURNAL.

The meetings of the section were full and interesting. One of the sessions was interrupted by the introduction of Dr. Chas. E. West, of Brooklyn, a founder of the Association, who gave reminiscences of Joseph Henry and exhibited a small helix made by Prof. Henry and used by him in conjunction with Dr. West on July 10, 1842, to magnetize needles during a thunder storm. Dr. West also exhibited a fragment of wood from the ship of Captain Cook, given him by the elder Silliman sixty years ago. The remarks of Dr. West were listened to with profound interest and the section tendered to him a vote of thanks.

The section enjoyed a visit to the home of Mr. Edgar B. Stevens, a manufacturer