of observances regarding the killing of the bear. While all the eastern Algonkins have observances of this order, they seem to have become much more elaborated among the Eastern Cree.

Pottery was unknown, steatite taking its place. Semilunar knives, here used as scrapers, other knives and some arrow points were rubbed out from slate. In some parts, at least, arrow points seem to have been chipped; and in others, made of bone and antler. The grooved axe was used. Basketry, except simple vessels of birch or pine bark, was unknown. Birch bark canoes were used.

Syllabics, invented by missionaries, are now used for communication in their own language, though the Cree still employ mnemonic devices of their own invention for the same purpose. Information was obtained which seemed to show that in olden times pictorial writings on birch bark, similar to those found among the Ojibways, were known. The primitive form of art seems to have been painting, and the lines employed were geometric.

Little folk-lore was collected, and this was, in the main, typically Algonkin, but some apparently resembles the Esquimau.

A comparison of the writer's notes with Lucien M. Turner's account of "The Nenenot or 'Naskopie'" Indians,[1] and conference with Indians and white men who had been in the Naskapi country, seems to show that the culture of these people is identical with that of the old Cree. Considering the absence of agriculture, the lack of village life and clan systems, the loose social and political organization, the absence of pottery and the ordinary forms of fabrics, and the comparative difference of artifacts in general, as here noted—it may perhaps be well no longer to consider the region inhabited by the Eastern Cree and the Naskapi as belonging to the Eastern Woodland culture area, a region characterized throughout by its agricultural and village life, its comparatively highly developed social and political organization, its pottery, clothing made from skins tanned without the hair, fabrics, woven basketry, and the like. Dr. Frank G. Speck, of the Department of Archeology of the University of Pennsylvania, who spent last summer among the Montagnais of Lake St. Johns, arrived independently at the same conclusion in studying these people. It is the suggestion of the writer, then, that the culture of the region of Subarctic Eastern America inhabited by the Cree, Naskapi, and Montagnais, might better be known hereafter as the Eastern Subarctic, or Labradorean, cultural area, as it is apparently so different from the eastern woodland area with which it has hitherto been classed.

[1] Lucien M. Turner, "Ethnology of the Ungava District," Eleventh Annual Report, Bureau of Ethnology, 1889–90, pp. 167–350.

Alanson Skinner
American Museum of Natural History

## *THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE SECTION A—MATHEMATICS AND ASTRONOMY*

Comparatively few papers on pure mathematics appeared on the program of Section A in view of the fact that the American Mathematical Society held its annual meeting in affiliation with the association. The address of the retiring vice-president, President E. O. Lovett, the Rice Institute, Houston, Texas, was read by the secretary of the section. It was entitled "The Problem of Several Bodies, Recent Progress in its Solution," and an abstract of it has appeared in a recent number of Science.

The following members of the section were elected as fellows of the association: David R. Allen, Joseph Allen, R. B. Allen, Harriet W. Bigelow, Oskar Bolza, W. H. Bussey, B. E. Carter, E. F. Chandler, Abraham Cohen, E. H. Comstock, H. A. Converse, S. A. Corey, J. A. Cragwall, F. F. Decker, C. C. Engberg, F. C. Ferry, F. E. Fowle, Philip Fox, William Gillespie, C. C. Gore, C. O. Gunther, U. S. Hanna, A. E. Haynes, Alfred Hume, W. J. Hussey, Kurt Laves, A. H. McDougall, Max Mason, Frank E. Miller, J. S. Miller, W. F. Osgood, J. M. Page, M. T. Peed, James Pierpont, S. C. Reese, W. J. Rusk, P. L. Saurel, G. T. Sellew, E. B. Skinner, A. G. Smith, D. E. Smith, P. F. Smith, Joel Stebbins, R. P. Stephens, L. B. Stewart, H. D. Thompson, E. B. Van Vleck, Oswald Veblen, H. S. White, F. S. Woods.

The sectional committee of Section A nominated the following members of the association,

who had not affiliated with any particular section, for fellowship in the association: Eugene Davenport, dean of the College of Agriculture, University of Illinois; E. K. Putnam, acting director of the Davenport Academy of Sciences; J. E. Stubbs, president of the State University of Nevada. These were also elected as fellows by the council.

In addition to the address of the vice-president, the following sixteen papers were read before the section:

1. V. M. Slipher: "The Spectrum of Mars."

2. E. B. Frost and J. A. Parkhurst: "Spectrum of Comet Morehouse."

3. E. E. Barnard: "On the Changes in the Tail of Comet Morehouse."

4. Frank Schlesinger: "The Orbit of the Algol-type Variable Delta Libræ."

5. Milton Updegraff: "The 6-inch Transit Circle of the U. S. Naval Observatory."

6. F. R. Moulton: "On Certain Implications of Possible Changes in the Form and Dimensions of the Sun, and Some Suggestions for Explaining Certain Phenomena of Variable Stars."

7. R. H. Baker: "On the Spectra of Alpha Virginis and Similar Stars."

8. F. C. Jordan: "The Orbit of Alpha Coronæ Borealis."

9. E. B. Frost: "Radial Velocities in Professor Boss's Star Stream in Taurus."

10. Philip Fox and Georgio Abetti: "The Interaction of Sun-spots."

11. Harris Hancock: "Elliptic Realms of Rationality."

12. Artemas Martin: "Algebraic Solution of the 'Three Point' Problem."

13. J. B. Webb: "Esperanto and a Sexdecimal Notation."

14. J. A. Miller and W. R. Marriott: "Comet Morehouse."

15. L. A. Bauer: "On the Interpolation Formula of Geophysics."

16. H. W. Fisk: "A Graphical Aid to the Determination of Latitude and Azimuth from Polaris Observations."

In the absence of their respective authors the paper by V. M. Slipher was read by J. A. Miller; the joint paper by E. B. Frost and J. A. Parkhurst was presented by W. S. Eichelberger; the three papers by Frank Schlesinger, R. H. Baker and F. C. Jordan, respectively, were read by J. A. Brashear; F. R. Moulton's paper was read by E. D. Roe; G. F. Hull presented the two papers by E. B. Frost and by Philip Fox and Georgio Abetti, respectively; the papers by E. E. Barnard and Artemas Martin, respectively, were read by title. The remaining papers were read by their respective authors and the abstracts which follow bear numbers corresponding to those of the titles in the list.

1. The paper by Mr. Slipher gives the results of a photographic investigation of the extreme red end of the spectrum of Mars made with special reference to water-vapor in the planet's atmosphere. It is a part of an extensive and detailed presentation which is to appear in the *Astrophysical Journal.*

2. The comet was observed photographically with a prismatic camera or with a quartz spectrograph on fifteen nights. The third and fourth carbon bands were identified, and the first, third and fourth bands of cyanogen. The plates taken with the objective prism over the six-inch Zeiss doublet show well the separate spectral images of the tail, running off the plate in most cases at a distance of over 3°. Wave-lengths were given off from unidentified bands. A brief account of the observations by E. B. Frost and J. A. Parkhurst appeared in SCIENCE, January 2, 1909.

3. Professor Barnard's paper deals with the remarkable changes in the appearance of the comet and of its tail as shown by the photographs of it, and an attempt to explain the phenomena.

There were a number of outbreaks in the comet in which volumes of matter were thrown off which could be traced for several days, on the photographs, as they receded from the comet. On one occasion the tail was violently curved and switched forward in the direction of its lateral motion. At another time the masses not only receded from the comet, but their lateral motion was also accelerated and became greater than that of the comet in the same direction. This acceleration was apparently in defiance of the laws of gravitation.

It is suggested as an explanation of these anomalous phenomena that disturbances of some kind occur in the interplanetary spaces, perhaps temporary in their nature and location, which may accelerate or retard, and bend or break the tail of a comet when they are encountered by it. It is suggested, also, that these regions of disturbance may be due to the same or a similar cause as that which produces magnetic disturbances on the earth—that is, that they are due to forces which are encountered by the comet and which have their origin in disturbances on the sun. An encounter of this kind might account for the sudden brightening of some comets, such as that of Sawerthal's in May, 1888. It might also cause the disruption of large volumes of the

cometary matter such as are shown in the photographs of Morehouse's comet on October 15, etc.

4. Sixty spectrograms of this Algol-type variable were obtained at the Allegheny Observatory during this year. These indicate a nearly circular orbit with a range of 146 kilometers per second. The center of gravity of the system is approaching us at the high rate of 46 kilometers per second. The light curves of this variable has been the subject of a recent exhaustive investigation by Kron. A study of the results obtained by him, and of the spectrographic data, enables us to infer the following with regard to the constitution of the system, upon the assumption that the light changes are caused by an eclipse. The two stars in the system have nearly equal diameters (about two and a half that of the sun), but one of them is nine times as bright as the other. Their average separation is about one thirtieth of that between the earth and the sun. If we assume that the two stars are equally dense the mass of each would be about six tenths and the density about one twenty-fifth that of the sun.

In discussing a series of measurements made two years ago upon $\beta$ *Persei*, Professor Schlesinger showed that in the case of this star there is a discrepancy between the phase demanded respectively by the light and velocity changes. Further investigation has confirmed the reality of this discrepancy and has shown that it can not be accounted for by any uncertainties in either the photometric or spectrographic data. It is interesting to notice that the same discrepancy is present in the orbit of $\delta$ *Librœ*. In this case the light phase lags more than two hours behind the velocity phase. The discrepancy is, therefore, somewhat greater than in the case of $\beta$ *Persei*, but it is in the same direction.

5. Professor Updegraff gave the following account of the six-inch transit circle of the U. S. Naval Observatory:

This instrument was acquired by the Naval Observatory with a view to its employment in doing fundamental work. The nine-inch brass transit circle made by Pistor and Martins, of Berlin, and mounted in the old Naval Observatory in 1865 was considered unsuitable for fundamental work of the highest class, and after the removal of the observatory to the new site on Georgetown Heights about the year 1893, the new six-inch steel transit circle was designed by Professor Wm. Harkness and was built by the well-known instrument makers, Warner & Swasey, of Cleveland, Ohio. The instrument was mounted in the west transit circle house at the new Naval Observatory in December, 1897, and was first brought into use in June, 1899. A description of the six-inch transit circle may be found in volume III., Part 4, of the *Publications* of the Naval Observatory, together with an account of the work done with it up to March, 1901.

The design of the instrument is substantially the same as that of the later Repsold meridian circles, and certain features have been the subject of considerable controversy. It was, I think, the first large instrument of this kind to be built of steel, which being a much stiffer metal than brass is expected to diminish errors due to flexures. This feature has been much criticized, but the example set by Professor Harkness has been followed by the Repsolds in making the new transit circle for the observatory at Kiel, Germany, which is also of steel, and the prospect is that steel or some other rigid metal will finally be recognized as preferable to brass for the construction of large instruments of this kind.

When brought into use the new instrument was found to have various defects, the most important of which, an extraordinary variability in azimuth, was found to be intimately connected with temperature. After a very troublesome investigation this was found to be due to two causes. The cast-steel bed plates which supported the instrument were, through non-homogeneity of the metal, distorted by temperature changes, and the marble piers of the instrument were not properly supported on their foundations. New bed plates of cast iron were provided, and the marble piers of the instrument were replaced by brick piers. These measures gave relief, and rendered the instrument remarkably stable in azimuth.

A peculiar but not serious difficulty has arisen from the construction of the tube of the telescope of steel. In a brass telescope of moderate size the changes in focal length of the object glass with temperature is nearly the same as the expansion and contraction of the tube with changes of temperature. But the coefficient of expansion of steel is smaller than that of brass, and in the case of the tube of the six-inch transit circle is not sufficient to make up for the change of focus of the object-glass. This makes necessary a change of stellar focus from winter to summer and vice versa.

In the fall of 1901 the instrument had been put in good condition, and for about one year following was employed in observations of the fixed stars and also in observations of the sun, moon and planets. The latter work with the instrument was continued up to September, 1903, when work

was discontinued, and practically no observations have been made with it since that time. In 1906 a transit micrometer made by Warner & Swasey was substituted for the old eye-end and a few practise observations were made by various observers.

The plan for the future work of the instrument is given in a general way in the report of the superintendent of the U. S. Naval Observatory for the fiscal year ending June 30, 1908, which has just been issued. This plan involves an attempt to render the observations of the sun and fixed stars and, consequently, of all bodies which are referred to them, of as strictly fundamental a character as is practicable.

The importance of such work to the science of astronomy and in the plan of work of an observatory maintained by the government is generally recognized by astronomers. It is expensive and laborious and in some respects perhaps less attractive than some other kinds of astronomical work in that it can not excite the interest or occupy the attention of the general public to any great extent. But for its proper performance, technical qualifications of a high order are required. Partly for these reasons, no doubt, this work has, with a few notable exceptions, not been as efficiently done in the observatories of the world generally for many years as is needed for the advancement of astronomy.

All accurate observations of the positions of the planets depend on this work and it thus becomes in some degree necessary for the further advancement of celestial mechanics. It is equally important for the solution of that greatest problem of physical science, the constitution of the visible universe, which must perhaps wait on further lapse of time and increase in accuracy of the observations of the places of the stars.

The late Professor Asaph Hall, U.S.N., was much interested in this kind of astronomical work, as may be seen by consulting the *Ast. Nach.*, No. 1692.

6. The problems treated in the paper by Professor Moulton are: (1) The theoretical shape of the sun, (2) the character and period of its possible gravitational oscillations, (3) the effects of changes of its dimensions upon its rate of rotation, (4) its energy of rotation, (5) its potential energy, (6) its temperature and rate of rotation and (7) applications of the same ideas to variable stars.

The results are: (1) the sun is oblate and the theoretical difference in its polar and equatorial diameters is less than 0″.01. (2) Its gravitational oscillations are expressible in spherical harmonics whose periods depend upon their order. Assuming the sun to be a homogeneous liquid, the longest period is 3 h. 8 m. If it has the viscosity of water this oscillation will change to 37 per cent. of its value in $2.2 \times 10^{15}$ years. (3) The change of the sun's diameter by 0″.1 will change its period of rotation by 7.8 minutes. (4) The formula was found for the change in the rotational energy. (5) The formula for the potential of spheroid of polar radius $c$, equatorial $c\sqrt{1+\lambda^2}$, and mass $m$ upon itself is

$$V = \tfrac{3}{5}k^2 \cdot m^2/c\,(1 - \tfrac{1}{3}\lambda^2 - \tfrac{7}{175}\lambda^4 \cdots).$$

(6) The expansion of the sun by 0″.1 will decrease its temperature (assuming its specific heat is unity) more than 1,400° C., and if it obeys Stefan's law, diminish its radiation (assuming its temperature to be 6,000° before expansion) by more than 65 per cent. (7) It is shown how gravitational oscillations can explain many puzzling phenomena of variable stars, such as variable periods in the so-called eclipse variables, secondary maxima and minima, varying maxima and minima, etc. It is thought that these factors are supplementary even in those cases where the binary character of the star is certain, and that perhaps in certain classes of stars they may be the only causes of variability.

7. Spectroscopic binaries of the helium type may be divided for convenience into two classes: those of long period and high eccentricity, and secondly, those whose periods are short and whose orbits are nearly circular. Mr. Baker's paper relates to the latter and much more numerous class, of which *α Virginis* is typical. This class includes a large number of Algol variables, as a special case where the orbital inclination approaches 90°, if the eclipse theory of their light variation be assumed. The following conclusions were reached: The majority of spectroscopic binaries of the helium type belong to one class, they revolve in close proximity in nearly circular orbits of short period, they are Algol variables inclined at various angles, the spectra of both components are, in general, visible and similar, and the fainter components are less massive than the brighter ones.

8. The binary character of *α Coronæ Borealis* ($\alpha = 15^h\ 30^m$, $\delta = +27°\ 3'$) was discovered by Hartmann from six plates obtained at Potsdam in 1902 and 1903. The spectrum is of the type 1 a 2 in the Vogel classification.

One hundred and thirty-seven plates of this star were obtained at Allegheny Observatory between

April 2, 1907, and September 11, 1908. The emulsions used were Seed 27, Seed 23 and lantern slide. The lines K, H$\delta$, H$\gamma$, $\lambda$ 4481 and H$\beta$ were the only ones measured. On the lantern slide and Seed 23 plates numerous other faint lines were visible, and in some cases measurable, but were not used. Among them are the lines $\lambda$ 4128 (silicon), $\lambda$ 4227 (calcium), $\lambda$ 4233 (iron), $\lambda$ 4352 (magnesium), $\lambda$ 4472 (helium), $\lambda$ 4550 (iron). A dozen other lines could be approximately located, while still others were occasionally faintly visible.

Mr. Jordan found that the total range in velocity is 69.86 km. As the periastron point is in the fourth quadrant, the ascending branch of the velocity curve is steeper than the descending. The center of gravity of the system has practically no velocity in the line of sight.

No trace of a secondary spectrum can be seen.

9. In No. 604 of the *Astronomical Journal*, published on September 25, 1908, Professor Lewis Boss communicated an important paper entitled "Convergent of a Moving Cluster in Taurus." In this he presents the evidence, derived from their proper motions, that 39 stars in or near the *Hyades* are converging upon the same point. Radial velocities have been published by Küstner for three stars of the cluster, namely, $\gamma$, $\delta$ and $\epsilon$ *Tauri*. Assuming these values to be representative of the cluster, the radial velocities of the remaining stars can be inferred. They would range from 37 to 44 km. per second. Before the article was printed Professor Boss had privately called the attention of Professor Frost to his results and to the desirability, in so far as possible, of determining the radial velocities of the stars in the cluster. He accordingly added the 41 stars to the observing program of the spectrograph, and during the present autumn they have been observed, as circumstances permitted, chiefly by Messrs. Barrett and Lee.

The spectra of most of the stars are of the first type, so that the lines are generally diffuse and suitable for only the dispersion of the single prism which has been regularly employed for them.

There has not yet been opportunity to measure these plates and this note is merely given to state that this piece of work is in progress. Thus far 60 spectrograms have been obtained of 21 of the stars, the magnitude of which are mostly between 4.5 and 5.6.

It may be said from a preliminary examination of the plates that no star contradicts in sense the value presumptive from Professor Boss's researches, and in general the radial velocity appears to be of about the amount expected. Some of the spectra will hardly admit of accurate enough measurement to establish the accordance with the predicted values. This examination only indicates that the stars thus far observed are receding from the sun with velocities of about 40 km. per second. No inference can yet be reached as to the differences in radial velocity dependent upon the star's position in relation to the point of convergence.

We have been somewhat surprised at the large proportion of spectroscopic binaries already detected in this cluster. Six of those so far observed appear to be certainly of this character, and others are suspected.

The six are: *90 Tauri* and B.D. 15°.637, found by Mr. Barrett; *64 Tauri* and *97 Tauri*, found by Mr. Lee; $\theta^2$ *Tauri* and *69* (Upsilon) *Tauri*, found by the writer. The last two had been observed before Professor Boss called attention to the cluster. $\theta^2$ *Tauri* has also been detected as a spectroscopic binary at the Lick Observatory. Double lines are exhibited by the first two and last three stars.

10. The paper by Messrs. Fox and Abetti presents evidence proving occasional interaction of sun-spots. On spectroheliograms obtained on September 10, 1908, regions surrounding three spot groups then just past the central meridian were observed to burst synchronously into active eruption. The eruptions progressed until the interval between the two larger groups, about 120,000 miles, was completely and brilliantly bridged. The whole display lasted less than four hours. Successive plates, shown by lantern slides, revealed the progressive stages of the demonstration.

11. It is known that on the Riemann surface associated with

$$s = \pm \sqrt{A\,(z-a_1)\,(z-a_2)\,(z-a_3)\,(z-a_4)},$$

in which $a_1$ and $a_2$ are connected by a canal as are also $a_3$ and $a_4$, that every one-valued function of position which has everywhere a definite value is of the form

$$w = p + q \cdot s,$$

where $p$ and $q$ are rational functions of the complex variable $z$; and reciprocally every function of the form

$$w = p + q - s$$

is a one-valued function of position on this Riemann surface. If we denote two such functions by

$$w_1 = p_1 + q_1 \cdot s, \quad w_2 = p_2 + q_2 \cdot s,$$

then the sum, difference, product and quotient of the two functions $w_1$ and $w_2$ are functions of the form

$$w = p + q \cdot s.$$

Let $z$ take all real and complex values and consider the collectivity of all rational functions of $z$ with arbitrary constant real or complex coefficients. These functions form a closed realm, the individual functions of which repeat themselves through the processes of addition, subtraction, multiplication and division, since clearly the sum, the difference, the product and the quotient of two or more rational functions is a rational function and consequently an individual of the realm. This realm is denoted by $(z)$.

It is evident that if we add (or *adjoin*) the algebraic quantity $s$ to this realm we will have another realm, the individual functions or elements of which repeat themselves through the processes of addition, subtraction, multiplication and division. This realm includes the former realm. We shall call it the elliptic realm and denote it by $(s, z)$.

Owing to a theorem due to Liouville, the most general one-valued doubly periodic function is a rational function of $z$ and $s$. It is consequently a one-valued function of position in the Riemann surface and belongs to the elliptic realm of rationality $(z, s)$.

The elliptic or doubly periodic realm of rationality $(z, s)$, where

$$s = \pm \sqrt{A(z - a_1)(z - a_2)(z - a_3)(z - a_4)}$$

degenerates into the simply periodic realm when any pair of branch-points are equal, say $a_1 = a_2$; and into the realm of rational functions when two pairs of branch points are equal, say $a_1 = a_2$ and $a_3 = a_4$.

Thus the elliptic realm includes the three classes of one-valued functions: (1) the rational functions, (2) the simply periodic functions, (3) the doubly periodic functions. All these one-valued functions, and only these, have algebraic addition-theorems.

In other words, *all functions of the realm $(z, s)$ have algebraic addition-theorems, and no one-valued function that does not belong to this realm has an algebraic addition-theorem.*

*We have thus the theorem: The one-valued functions of position on the Riemann surface*

$$s^2 = A(z - a_1)(z - a_2)(z - a_3)(z - a_4)$$

*belong to the closed realm $(z, s)$ and all elements of this realm and no others have algebraic addition-theorems.*

Professor Hancock's paper will be offered to the *American Journal of Mathematics* for publication.

12. The paper by Artemas Martin is devoted to an algebraic determination of the point within a triangle at which the sides subtend given angles. The paper is to appear in the *Mathematical Magazine*, which is edited by the author of this paper.

13. The paper by J. Burkitt Webb is devoted to exhibiting the advantages which would result from the adoption of a system of notation with 16 as its base. The success which has attended the movements towards a universal language has inspired the author with hope in the success of a movement towards the selection of a more useful system of notation, and he pointed out the many advantages which the base 16 would offer.

14. This paper is devoted to a discussion of a series of photographs of comet Morehouse, made at Swarthmore College by J. A. Miller and W. R. Marriott from October 2 to December 3, 1908. The comet was photographed from one to three times every clear night within that period. These photographs show remarkable and, in some instances, rapid changes in the form of the comet's tail and in the arrangement of the streamers. The most striking changes occurred on October 4; on October 15, 16, 17, 30, 31 and November 1 the changes were sufficiently rapid to enable one to measure an increase of the distance of a condensation in the tail upon photographs taken less than two hours apart.

15. The rather prevalent custom of resolving or expressing every natural phenomenon—be it periodic or otherwise—by a Bessel or a Fourier series or by spherical harmonic functions, has brought about at times, especially in geophysical and cosmical phenomena, if not direct misapplications, at least misinterpretations of the meaning and value of the derived coefficients. Instead of clarifying the situation our calculations may have actually contributed to befog it. Instead of rejecting, one must learn to consider the outstanding residuals as the *true* facts of nature and not treat them as though they were "abnormal" or contrary to nature's law.

Dr. Bauer exemplified these statements in a brief discussion of two cases that are typical in geophysical investigations—the one involving an application of spherical harmonic functions to the representation of the distribution of the earth's magnetism over the earth, while the other involved the use of Fourier series in the representation of certain diurnal geophysical phenomena.

The chief purpose of the paper was to recall

renewed attention to the limitations, from a physical standpoint, of the form of "interpolation formulæ" usually employed in the representation of natural phenomena.

16. Mr. H. W. Fisk considers the formula for latitude,

$$\phi = h - p \cos t + \tfrac{1}{2} p^2 \sin 1' \sin^2 t \tan h,$$

from Chauvenet's I., § 176, and the formula for azimuth,

$$A = p \sin t \sec \phi + p^2 \cos \phi \tan \phi \sin t \cos t \sin 1',$$

from Jordan, "Zeit und Orts-Bestimmung," p. 122. The first terms of these formulas are readily computed. The last terms, called correction terms, are arranged as a set of curves from which the value is quickly taken by inspection. The geographical limits within which this method may be used, as well as the expected accuracy under different conditions are discussed. Attention is given to the change in correction terms due to the progressive change in the value of $p$.

The general committee elected Professor E. W. Brown, Yale University, vice-president and chairman of the section. Professor G. A. Miller, University of Illinois, continues in office as secretary. The section elected Professor G. B. Halsted, councilor; Professor Winslow Upton, Ladd Observatory, as member of the sectional committee for five years.

G. A. Miller,
*Secretary of Section*
University of Illinois

## *Societies and Academies*

### The Washington Academy of Sciences

The fifty-first meeting of the Washington Academy of Sciences was held at Hubbard Memorial Hall, January 5, 1909. Dr. L. O. Howard presided.

Dr. E. B. Poulton, F.R.S., Hope professor of zoology in the University of Oxford, delivered an address on "Recent Researches on Mimicry and Seasonal Forms of Butterflies," of which he has kindly furnished the following abstract:

The lecturer explained the theory of mimicry proposed by H. W. Bates, showing in illustration some of the figures from the plates of the original monograph read before the Linnean Society of London, November 21, 1861. In these, as in most of Bates's examples, Pierine butterflies, presumed to be palatable to enemies, were seen mimicking the unpalatable Ithomiine (Heliconine) butterflies from the same localities. Succeeding illustrations exhibited oriental Pierine butterflies of the genus *Delias* acting as models instead of mimics, and beautifully resembled by moths of the subfamily Chalcosiinæ (Zygænidæ)—themselves admitted to belong to a group defended by its unpalatability. Such examples are of course inexplicable by the theory of Bates, but receive an interpretation on the hypothesis of Fritz Mueller, which supposes that the resemblance between distasteful forms has been gained in consequence of the saving of life effected by a lessened amount of experimental tasting by enemies. That the same Muellerian principle holds in other groups is seen in the numerous and varied distasteful forms which mimic the African Lycid beetles and by resemblances between well-defined wasps of different groups in the same locality.

The alternative between a Batesian and Muellerian interpretation may be approached from another point of view. In the case of a distasteful butterfly invading a new country we may enquire whether the indigenous species influenced by it are well concealed and presumably palatable, or conspicuous and presumably distasteful. The two large Danainæ of North America are especially interesting from this point of view. Formerly placed by Moore in two genera peculiar to the new world, *Anosia* and *Tasitia*, recent examination has shown that they are congeneric with each other and with the more dominant old world *Salatura* and *Limnas*. All four genera certainly sink to *Danaida*. The old world forms are more numerous and are far more extensively mimicked than those of the new. They, furthermore, enter into mimetic relations with other *Danainæ*. The American species of *Danaida*, on the other hand, are only mimicked by a single Nymphaline species in the north. They extend through South America beyond the southern tropic without entering into any relationship with the indigenous butterfly fauna, except the possible incipient mimicry of a form of *D. plexippus* by an *Actinote*, one of the Acræinæ. It may be inferred from these facts that *Danaida* is an old world Danaine genus which has reached the new world in comparatively recent times and has entered South America by way of North America.

The well-known mimic of *D. plexippus*, *Basilarchia* (*Limenitis*) *archippus* has been evolved from *B.* (*L.*) *arthemis*—with a pattern of the *Limenitis* type found through the temperate circumpolar belt. In the theory of the production of mimetic resemblance by climatic or other local influences the invading Danaine should have been influenced to produce a *Limenitis* pattern in the northern temperate zone. It should have been the mimic instead of the model. The black and white