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.

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FRIDAY, JANUARY 3, 1902.

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THE RELATIONS BETWEEN THE VARIABILITY OF ORGANISMS AND THAT OF THEIR CONSTITUENT ELEMENTS.

IN a study of the varying forms of organisms we may either direct our attention to the variability of the organism as a whole, or to the variability of its constituent elements. When two organisms differ in form, their differences are necessarily founded on differences in the forms of their corresponding parts, and we are justified in assuming each of these parts as very small. The corresponding parts may consist of homologous cell groups, of individual cells, or of other small homologous elements of the two organisms. These small elements may differ in size and form, and new elements may also be added in the one or the other organism, so that there may also be a difference in the number of elements. The difference between the two organisms may then be considered as a resultant of the differences between their constituent elements. Therefore, there must be a certain definite relation between the variability of the elements and that of the whole organism.

In order to make this clear we will, for a moment, consider the elements as independent units, not as parts of an organic whole. In this case, each element would be entirely independent of the other. When we consider two organisms thus constituted in which the total number of cells is the same, we find that they cannot possess any variability, because the variations of the constituent cells would compensate each other. This can be proven as follows: If we determine the form of an organism by a number of measurements taken in various directions, then each measurement may be considered as made up of many constituent elements. On the average, the variability of the combined elements will be proportionate to the square root of the number of elements, while the value of the total length of the combined elements will be proportionate to their number. If, therefore, the number of elements is very great—and there is nothing to hinder us in assuming each element as very small and their number as very great—the variability of the whole measurement must be very small, according to the small value of the proportion between the square root of the number of elements, and the number of elements. Since this contradicts the fact that all organisms are variable, it follows that the elements cannot be constant in number and mutually independent. This conclusion is obvious from a morphological point of view, but it seemed desirable to point out that the independence and constant number of elements would entail lack of variability in the whole organism.

If the elements were independent of each other but varied in number, we might assume in accordance with morphological observation that each group of elements had a certain limited period of multiplication which proceeds at a definite average rate. Then it may be said that this period undergoes certain changes that are due to chance. If this were the case, the size of the organ would increase approximately in geometrical progression when the period increases in arithmetical progression.

It is probable that, on the whole, the periods of development of various organisms vary around the typical period according to the laws of chance. Then the frequencies of periods belonging to different individuals would be arranged symmetrically around the typical period, while the measurements corresponding to each period and belonging to different individuals would be arranged asymmetrically around the type, in accordance with the relations between size and period. It is quite evident that the observed distributions of variations around a type do not generally conform with a law of this character, and therefore this theory must also be rejected as insufficient, although we recognize that it may explain a part of the general phenomena of variability.

It is, therefore, necessary to assume the elements of organisms to be correlated. This is entirely in accord with the evidence of morphology and of pathology. If the number of elements is assumed as constant, it is easy to determine what the results of such correlation must be. 'Correlation' means that the change in form and size of one element influences more or less the forms and sizes of other elements. Such correlated elements may either be contiguous, or they may be related in some other way. The degree of their relation may be expressed by an index of correlation.

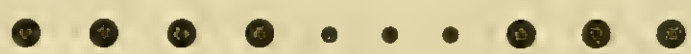
If the correlation of all the elements were perfect, that is to say, if a change in one would necessitate a corresponding change of a certain definite amount in all the others, the variability of the whole organism would be proportioned to the average variability and number of the homologous elements. This condition is as unlikely as that of complete independence of the elements. We must draw the conclusion that the variability of the organism as a whole will always be less, in proportion to its size, than the variability of its constituent elements; or, as we might perhaps say, the variability of the individual cells that constitute an organism must always be greater than the variability of the whole organism.

It may be well to illustrate the effects of correlation by assuming simplified conditions of correlation.

Assuming first, that the elements may be classed in a limited number of groups, each consisting of interdependent elements, so that the enlargement of one element of each group would necessitate a definite amount of enlargement of all the others. Furthermore be it assumed that the chances of a small number of these groups being enlarged are subject to accidental causes. Then the probability that one, two, three, or more of these groups are affected can be calculated according to the binomial law. Each group would contribute a definite, invariable amount to the total variability and the general variability would, therefore, also conform to the binomial law.

We will next assume a case which is somewhat nearer natural conditions. When we count and measure the total number of elements in *all* the individuals of a variable series, we obtain certain definite numbers of elements of various sizes and we can express numerically the frequency or probability of each size. In order to simplify matters, we will speak only of elements of decreased size and of enlarged size. The proportion of these two classes is definite in the total number of elements belonging to the different organisms of the series. If inside of each organism there were no correlation, then the proportion of large and small elements in each organism would, on account of the great number of elements, correspond to their proportions in the whole mass of elements. On account of the existence of correlations in each organism the occurrence of each enlarged element will have the effect, that an additional number of enlarged elements may be expected in the same organism, and the occurrence of an element of decreased size will add to the probability of elements of this character in the organism in which it occurs. The arrangement of these elements becomes, therefore, similar to that in a mechanical mixture of elements of two sizes, which are not uniformly distributed, but in which large and small parts cluster together. It is quite clear that the variability of distribution in such a mixture must be quite different from that found in cases of even mixture. It will depend entirely upon the distribution of large and small elements, and the number of elements of both classes that are found in a unit of space, how their proportion in each unit of space will vary.

We may obtain an insight into such variabilities by a consideration of the results obtained by taking a certain number of contiguous balls out of a row containing large and small balls that are not thoroughly mixed. The two arrangements given under 1 and 2 may serve as examples:

1. 

2. 

If four contiguous balls are taken out of each of these rows, we find that in the drawings made from the two series large balls occur as follows:

	Series 1.	Series 2.
4 large balls	1 Time	0 Times
3 " "	2 Times	3 "
2 " "	2 "	3 "
1 " ball	2 "	1 Time

Evidently, the distribution in cases of this kind cannot be foretold. This result may be expressed in a more general form as follows: If only one series of elements of an organism are interdependent, and all the others independent, the variability of form of all the individuals will depend primarily upon the distribution of disturbances in the interdependent elements in the whole series of individuals. Therefore the distribution of variations cannot be foretold. The same is true if the number of groups of interdependent elements is small.

When, however, the number of these groups of interdependent elements is somewhat greater and each group of correlations is independent of the other, then the conditions approach again those described before, when we assumed a number of groups in which the size of one element of a group determines the sizes of all the other elements of the same group. We may then expect to find a distribution the type of which is determined by the binomial law, because the combinations of groups that occur in each individual are determined by this law, while the law must be modified by the variability of the size of each correlated group, taken as a total. It is quite evident that the resultant curve must be similar in its general character to the series of binomial points, but continuous on account of the variability of each group. This phenomenon is still further complicated by the variation in the number of elements, the effect of which was discussed before.

We may reach the same result by assuming that the form of the whole organism is affected by a limited number of causes variable in intensity, each of which influences to a measurable degree the form of the organism. The combination of such groups of independent causes, limited in number and each having measurable results will bring about a distribution of variations of the same character as the one described before. The phenomenon, expressed in this manner, does not differ from the expression found before, because it does not seem probable that each cause would affect all the elements comprising the organism in the same manner. It seems much more likely that certain groups of elements will be affected more by one cause than by another. At the same time, it is possible that the same element may be subject to several causes and thus belong to various groups of correlated elements. Karl Pearson's discussions have shown that many distributions can be explained satisfactorily by assuming that they correspond to a continuous function determined by the points binomial.

It will be noted that, on the whole, the greater a variable measurement, the more nearly will the distribution of variations be symmetrical and in conformity with the exponential law. This may be expected, because the greater the measurement, the greater will probably be the number of independent, correlated groups. The increase of their number necessitates an approach to the exponential law. On the other hand, the smaller the measurement, the more probable that a great part of its constituent elements are subject to the same causes, so that the conditions are favorable to the combination of a small number of independent causes, each of which brings about considerable variation, so that we may expect as a resultant skew distributions of variations.

It would seem, therefore, that the whole range of phenomena of variability can be understood on the basis of our conception of the relations between the variability of the small constituent elements of an organism and the variability of the organism itself. We are justified in drawing the following conclusions:

1. The elements of organisms are more variable than the organisms themselves.

2. The elements of organisms vary in correlated groups.

3. The characteristics of the variability of an organism depend upon the correlations of its constituent elements, so that a knowledge of these correlations will enable us to determine the characteristics of the variability of the organism.

It follows from this that the problem of variability may be treated by a study of the variability and of the correlations of the constituent elements of organisms. The study of physiological and pathological variations that elucidate correlations will, therefore, be a most powerful factor in the discussion of the problem of variability.

This point of view coincides closely with that of Rudolf Virchow who has always emphasized that the clue for the problems of variability must be looked for in the study of cellular variation.

Under certain simplified assumptions the problem, as here defined, may be made amenable to statistical treatment. If all the contributory causes of variation are given equal weight, and if it is assumed that the index of correlation for all the groups is the same, then it is only necessary to determine four unknown quantities: the total number of causes (or correlated groups); the probable number of causes (or correlated groups); the amount of influence of each cause (or correlated group) upon the whole organism; the variability of the effect of each cause (or correlated group) upon the whole organism. These few data can be calculated without any great difficulty from the averages of the first four powers of the individual variations. This method may be serviceable as long as the actual correlations are unknown.

Still another conclusion may be drawn from our considerations. We have seen that the variability of an organism depends upon the correlations of its elements, and that the variability must be the greater the closer these correlations and the less the number of correlated groups. At the same time, the variations will be the more likely to have skew distributions, the less the number of correlated groups. A disturbance in one element of an organism thus constituted must, therefore, result in a considerable variation of the whole. That is to say, that in the case of skew distributions of variations we may expect sudden transformations of type due to small causes. In organisms in which the variability is symmetrical, we may generally expect the whole form to be controlled by many independent causes, or by many independent groups of correlated elements. In this case, the changes of form due to small changes of conditions will probably be less marked.

The principal advantage of the method of considering variation that has been here suggested is that the occurrence of variations in fixed lines, that are so difficult to understand, may be considered as a result of chance variation of small elements and of physiological correlation. Both of these are much more readily understood than a variation of form that does not show any immediate relation to the causes producing the variation.

It has often been asserted, or assumed, that skew distribution of variations is a proof of the effect of selection, or of some other kind of instability of type. Our considerations have shown that this is not necessarily the case. Skew distributions may be found in stable forms. On the whole, it does not seem possible to discover by purely statistical methods the causes of skewness. The numerical material obtained by measurements can be made to fit satisfactorily many theories that would account for the skewness. It is necessary to base such theories on biological investigations and to subordinate our statistical methods to the biological point of view. Otherwise the result of statistical inquiry will be of little use and may even become quite misleading.

FRANZ BOAS.

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*ON THE TRUE NATURE OF TAMIOSOMA.**

IN 1856 the late T. A. Conrad described a remarkable fossil from California, under the name of *Tamiosoma gregaria*, composed of large tubes with a longitudinal cellular

* Communicated by permission of the Director of the U. S. Geological Survey.

structure, closed and tapering to a relatively small point of attachment below, nearly filled with a vesicular mass of shell laminæ internally, preserving a smooth-walled body cavity with a reflexed margin at the upper end, without any trace of subdivision in the walls, or dentiform processes. He pointed out some similarities in the form of the aperture to the sessile barnacles (*Balanus*) from which animals the undivided tube structure seemed to definitely separate the new organism. Subsequently he described an imperfect specimen as a *Balanus* (*B. estrellanus* Conrad, 1857), but still later (1864) he referred it to *Radiolites,* in the course of some rectifications of his earlier papers, and stated that it was characteristic of the Cretaceous of California.

In 1866 Gabb stated ('Pal. Cal.,' II., p. 62) that it was a fossil of 'the Bituminous shale, the best marked member of our Upper Miocene,' and referred it to the Hippuritidæ, an opinion provisionally accepted by Stoliczka in 1871,* notwithstanding the fact that the upper valve was unknown and the supposed lower valve showed no traces of muscular impressions, pallial line or tooth sockets. Tyron,† in 1884, copies Gabb's remarks without comment. Zittel‡ and Barrois, in 1887, regarded it as a problematical organism possibly referable to the corals, while in the same year Fischer expresses the opinion§ that it is more like a large barnacle than a Hippurite. Most of the manuals and check-lists prudently omit all reference to it.

During the past season Mr. Homer Hamlin of Los Angeles sent to the writer a collection of fossils from southern California containing numerous Miocene types, including *Lyropecten magnolia* and *L. Heermanni* Conrad, from a horizon of which the matrix is a cemented calcareous gravel (not the bituminous shale), containing several examples of *Tamiosoma;* not only the gregarious colonies, such as were described by Conrad, but also solitary individuals and certain flat saucer-like, concentric valves with reflected edges, which were naturally taken to be the long-sought upper valves. One solitary individual appeared to have this flat valve *in situ* and a sagittal section of it was made, to study the relations of the body cavity. It may be mentioned in passing that all the material in the beds from which these fossils came has been more or less crushed so that perfect specimens are extremely rare.

The result of the sectionizing was most unexpected. There was no body cavity and the flat saucer-like portion proved to be merely the basal portion of the tube, which in solitary individuals starts from an extremely small point of attachment to some object and grows concentrically in a flat form until it is an inch or two in diameter, after which it changes its manner of growth and rises in columnar fashion. In the gregarious groups the growth forms an inverted cone, owing to the mechanical difficulties in the way of lateral expansion. A section of the shelly matter showed that it is entirely destitute of the prismatic layer of the *Hippuritidæ,* and that the structure of the shell is precisely that of the sessile cirripedes. Since the tube is entire and not divided into valves, and is quite destitute of any radial structure, it was evident that the organism is not homologous with the valvular case of the sessile barnacles, which is always divided into plates more or less distinctly fused with one another, and that it cannot be a coral.

The only remaining alternative then appears to be that the fossil described by Conrad is homologous, not with the valvu-

*'Cretaceous Pelecypoda of India,' p. 239.

†'Structural and Systematic Conch.,' III., p. 206.

‡'Traité de Pal.,' II., p. 86.

§'Man. de Conchyl.,' p. 1064.

lar portion of *Balanus,* but with the base, which in the latter genus is not only entire, but under suitable conditions assumes a tubular conical form, and in one species, the *Balanus lævis* of Darwin, sometimes has the lower portion of this tube more or less filled with a vesicular mass of shell substance closely resembling the tube of *Tamiosoma.** This conclusion was fortified by the discovery of an undoubted species of *Balanus* in the same horizon as that of *Tamiosoma,* forming a tubular base like that of *B. lævis,* though much smaller, in the proximal portion of which a certain amount of vesicular filling had taken place. Lastly, complete confirmation was attained through the kindness of the authorities of the State Mining Bureau of California which at the intercession of Dr. J. C. Merriam, of the University of California, forwarded a unique specimen which had been supposed to exhibit an 'upper valve,' but in which the subconic base filled this rôle, while a careful cleaning of the much-crushed but otherwise nearly intact 'base' revealed the remains of six very solid valves typical of the genus *Balanus,* and the cavity, now filled with gravel and fragments of the shell, in which the soft parts of the animal had originally been enclosed. These valves were so crushed and worn that a complete figure of the valvular summit of *Tamiosoma* is not yet attainable, but the fact that the valves are smooth, except for the rude concentric rugosities due to resting stages and other exigencies of growth, and that they agree with the typical *Balanus* in number and general character, is conclusively demonstrated.†

It is interesting to discover new types of animal organisms, but perhaps still more so to be able to place those already known to some extent, but whose relations, in the absence of complete information, have been so differently estimated as in the present case. It only remains for systematic students of the cirripedes to determine whether the notable peculiarities of growth of this singular fossil warrant the retention of the name *Tamiosoma* in a subgeneric or sectional sense, or whether it shall be relegated to the genus *Balanus* as a synonym.

*Darwin, Mon. Cirripedia, *Balanidæ,* p. 227, 1854. See figure of the variety *coquimbensis,* Plate 4, Fig. 2a, giving a section of the tubular base, partly filled with vesicular septa.

† Since the above was written a letter from Mr. Hamlin announces the discovery of a number of complete specimens with the valves.

Some time since, the supposed occurrence of *Radiolites* in a bed of clay pierced for a tunnel in the city of Los Angeles was noted in SCIENCE. A further examination of fossils collected from these clays by Mr. Hamlin shows that sixty per cent. of the mollusks are recent species, and the age of the deposit therefore Pliocene. Mr. T. W. Vaughan is confident that the fossil which was taken for the smaller valve of the supposed *Radiolites* is a solitary coral; and, while the other portion still remains problematical, it is highly improbable that it belongs to the group of Rudistes.

WM. HEALEY DALL.

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*THE RELATIVE PROGRESS OF THE COAL-TAR INDUSTRY IN ENGLAND AND GERMANY DURING THE PAST FIFTEEN YEARS.**

THE coal-tar industry is the flower of the chemical industries. It represents the highest development of applied chemical research and chemical engineering, and a country which allows the most scientific branch of chemical industry to languish cannot expect to maintain preeminence

* From a paper by Arthur C. Green read before the British Association (Section of Chemistry) at the Glasgow Meeting, 1901. This accurate statement of the present status of the coal-tar industry, and incidentally of the whole chemical industry, is of interest, not only to the audience for which it was prepared, but also to Americans. For this reason the most important portions of the paper are here presented.

long in any simpler branch of chemical manufacture. Skill trained for attacking the difficult problems of organic chemistry is certain, sooner or later, to be brought to bear on the simpler problems, and to result in improvements along the whole line of chemical industry, resulting in better products and cheaper production. This is well exemplified in the recent revolution in the manufacture of sulfuric acid. The manufacture of alizarin colors and artificial indigo has made a strong demand for cheap sulfur trioxid. With the object of satisfying their own requirements in this respect, the Badische Anilin and Soda Works of Ludwigshafen devoted much time and research to improving the catalytic process of Winkler. This endeavor was attended with such success that by means of the process and plant which they finally evolved they were enabled to produce sulfur trioxid so cheaply that it could not only be used for a large variety of purposes, but, by combination with water, afforded a profitable source of sulfuric acid. This new method of manufacturing sulfuric acid is, for concentrated acid at least, cheaper than the chamber process, and since the product is absolutely free from arsenic and can be produced at any desired concentration, it seems likely to supplant eventually the time-honored method of manufacture.

Besides exerting a stimulating influence upon the inorganic chemical manufactures, the coal-tar industry has given birth during recent years to several important daughter industries. The manufacture of synthetic medicinal agents, artificial perfumes, sweetening materials, antitoxins, nutritives and photographic developers, are all outgrowths of the coal-tar industry, and in great part still remain attached to the color works where they originated. The requirements of the coal-tar industry have further led to great advances in the design and production of chemical plants, such as filter-presses, autoclaves, fractionating columns, vacuum-pumps and stills, suction-filters, enameled iron, aluminum and stoneware vessels, etc., for the supply of which extensive works have become necessary.

Lord Beaconsfield said that the chemical trade of a country is a barometer of its prosperity, and it has always been regarded as a most important branch of English manufactures. Even those who might be inclined to regard our declining position in the color industry with more or less indifference would consider the loss of a material portion of our general chemical trade as nothing less than a national calamity. The two are, however, indissolubly connected.

It is with the object of ascertaining our present and future prospects in the chemical trade of the world that I propose to compare the relative development of the color industry in England and Germany during the past fifteen years. In 1886, in a paper read before the Society of Arts, Professor Mendola gave a masterly account of the position of the industry in this country at that date, and sounded a warning note to our manufacturers and business men regarding its future progress. These warnings, repeatedly given, have remained largely unheeded, and if the conclusions now forced upon us are unfortunately not of a reassuring nature for our national trade, it is well to remember that nothing is gained by burying our heads in the sand.

In no other industry have such extraordinarily rapid changes and gigantic developments taken place in so short a period —developments in which the scientific elucidation of abstract problems has gone hand in hand with inventive capacity, manufacturing skill, and commercial enterprise; in no other industry has the close and intimate interrelation of science and practice been more clearly demonstrated.

From 1858 to 1886 may be called the 'rosanilin period' of the color industry, since it was chiefly marked by the development of the colors of this group. A few individual members of other groups had been discovered, but had not attained importance. This is especially true of the 'azo' dyes, which have attained such importance that the last fifteen years may justly be called the 'azo period.' The number of individual compounds belonging to this class which have either been prepared or are at present preparable, runs into many millions, and far exceeds the members of all other groups of coloring matters put together. In commercial importance, also, they occupy a position at present far in advance of any other group; the employment of some of them, as the azo blacks, amounting to many thousands of tons annually. A great stimulus to the investigation of the azo compounds was given by the discovery by Boettger in 1884 of the first color possessing a direct affinity for cotton (Congo red), which was followed in a few years by a rapidly increasing series of colors of all shades having similar dyeing properties. The great simplification of cotton dyeing, brought about by the introduction of the new group of azo colors —'benzo' or 'diamin' colors as they are called—led to a rapid increase of their number. Simultaneously therewith proceeded the discovery and investigation of the various isomeric derivatives of naphthalene, required as raw products for the preparation of these colors.

Another method of applying azo colors to cotton, by which much faster shades are obtained, was introduced by Messrs. Read, Holliday & Co., of Huddersfield, in 1880, and consisted in producing unsulfonated azo compounds on the fiber by direct combination. Owing to technical difficulties this process has only reached its full development during the last few years, and that at other hands than those of its discoverers. The most important color produced by this method is paranitranilin red, for which over two hundred tons of chemically pure paranitranilin are manufactured annually.

The search for direct cotton colors led the author to the discovery of primulin in 1887, and this can be used for the synthesis of various azo colors on the fiber, which are remarkable for great fastness in washing. The new principle of dyeing which this introduced has been considerably extended in other so-called 'diazo' colors. The mordant azo colors have also, with the growing demand for faster shades, recently come into much prominence. The laborious scientific investigations of Fischer and Hepp, Bernthsen, Kehrmann and others on the azins, oxazins, and thiazins, have led to the discovery of many valuable new members of these classes, such as the indulins, rosindulins, rhodulins, etc. Much investigation has also been given to the pyrone and acridin groups, leading to the rhodamins, a class of pure basic reds, and to the basic yellows and oranges.

Next to the azo group, it is in the alizarin group that the greatest progress must be recorded. The demand for fast colors for calico-printing and for dyeing chrome-mordanted wool to withstand severe milling operations, has led to a long series of investigations and patents for producing new derivatives of anthraquinone—the anthracene and alizarin colors. The 'Vidal' blacks and other colors, for the direct dyeing of unmordanted cotton, are now being rapidly developed, although thus far their constitution has resisted elucidation.

It may be fairly claimed, however, that the greatest triumph of the coal-tar industry for the past fifteen years has been the successful production of artificial indigo on a large manufacturing scale.

Returning to the economic aspect of the subject, I will ask you to consider what share we have obtained in the great expansion of trade resulting from all these new discoveries, of which many have originated in this country. The development of the industry in Germany is well illustrated by the following figures:

Exports from Germany to the World.

	1885. Tons.	1895. Tons.	1899. Tons.
Anilin oil and salt	1,713	7,135	......
Coal-tar colors (excl. of alizarin)	4,646	15,789	17,639
Alizarin colors	4,284	8,927	......

The value of the exports of coal-tar colors from Germany in 1894 was 2,600,000 pounds sterling, in 1898 3,500,000 pounds, an increase of nearly a million in four years. The total annual value of the industry of Germany is hardly less than ten millions of pounds sterling. With the increase in the production of synthetic indigo it may be taken to-day to considerably exceed this figure.

One may well wonder what becomes of this enormous quantity of coal-tar products. According to the United States Consular reports the three and a half million pounds' worth of coal-tar colors exported by Germany in 1898 were consumed as follows:

The United States took	750,000	pounds' worth.
The Unted Kingdom took	750,000	" "
Austria and Hungary took	350,000	" "
Italy took	225,000	" "
China took	270,000	" "

whilst the rest of the world took the remainder.

The great increase in production in Germany is further shown by the growth in the capital and number of work-people employed. Thus, according to a report of the Badische Works recently issued, the capital of this company, which was increased in 1889 from 900,000 pounds to 1,050,000, will be further augmented this year by the issue of 750,000 pounds' worth of bonds. The number of work-people employed by this company in 1900 was 6,485, as against 4,800 in 1896, an increase of over thirty-three per cent. in four years. The firm of Leopold Cassella & Co., of Mainkur, near Frankfort, have increased the number of their work-people from 545 in 1890, to 1,800 in 1900.

In England we find that the imports of coal-tar colors are steadily rising, having increased from 509,750 pounds sterling in 1886 to 720,000 pounds in 1900. Contrasted with this, the exports of coal-tar colors manufactured in England have fallen from 530,000 in 1890 to 366,500 pounds sterling in 1899. It is therefore apparent that we have had little share in the great increase which this industry has experienced during the past fifteen years, and we have not been able even to supply the expansion in our own requirements. This is well shown by the following statistics of the two Associations who together form a very large proportion of the entire dyeing trade.

Coloring-matters Used by the Bradford Dyers' Association.

English	10 per cent.	Swiss	6 per cent.
German	80 per cent.	French	4 per cent.

Coloring-matters Used by British Cotton and Wool Dyers' Association.

Anilin colors	English	22 per cent.
	Foreign	78 per cent.
Alizarin colors	English	1.65 per cent.
	Foreign	98.35 per cent.

Out of a total of sixty tons of coloring-matters and other dyeing materials derived from coal-tar, used by the English Sewing Cotton Company, only 9 per cent. were of English manufacture.

The following table gives a fair picture of the present dimensions of the industry in Germany.

Compared with such figures as these, the English color manufacture assumes insignificant proportions. The total capital invested in the color industry in this country does not exceed 500,000 pounds, and the

POSITION OF THE SIX LARGEST COLOR WORKS IN GERMANY IN THE YEAR 1900.

	Badische Anilin Works.	Meister, Lucius and Brüning.	Farben Fabriken Bayer and Co.	Berlin Anilin Co.	Cassella and Co.	Far werk Mühlheim Leonhardt, and Co.	Total of Six Firms about.
Capital	£1,050,000	£833,000	£882,000	£441,000	Private concern	£157,000	£3,500,000
Number of Chemists	148	120	145	55	60	450	500
Number of Engineers, Dyers and other Technologists	75	36	175	31			350
Commercial Staff	305	211	500	150	170		1,360
Work People	6,485	3,555	4,200	1,800	1,800		18,260
Dividends (*per cent.*)							
1897	24	26	18	12½	not known	9	
1898	24	26	18	15	" "	3	
1899	24	26	18	15	" "	5	
1900	24	20	18	?	" "	nil	

total number of chemists employed cannot be more than thirty or forty.

A similar relative proportion is maintained in patents:

Comparison of Number of Completed English Patents for Coal-tar Products taken during 1886–1900 by Six Largest English and Six Largest German Firms.

German firms:

Badische Anilin Works	179
Meister, Lucius and Brüning	231
Farbfabriken Bayer & Co.	306
Berlin Anilin Co.	119
L. Cassella & Co.	75
Farbwerk Mühlheim Leonhardt & Co.	38
Total of six German firms	948

English firms:

Brook, Simpson & Spiller	7
Clayton Anilin Co.	21
Levinstein	19
Read Holliday & Co.	28
Claus & Reë	9
W. G. Thompson	2
Total of six English firms	86

Nor does this represent the sum total of our losses. The new coloring matters, made chiefly in Germany, have in many cases been introduced as substitutes for natural products, which were staple articles of English commerce. Madder and cochineal have been replaced and logwood and indigo are seriously threatened. The capture of the indigo market by the synthetic product, which would mean a loss to our Indian dependencies of three million pounds sterling a year is regarded by the Badische Company as so absolutely certain, that having already invested nearly a million pounds in the enterprise, they are at present issuing 750,000 pounds of new bonds to provide funds to extend their plant for this purpose.

Again, besides the loss of material wealth which the neglect of the coal-tar trade has involved to the country, there is yet another aspect of the question which is even of more importance than the commercial one. There can be no doubt that the growth in Germany of a highly scientific industry of large and far-reaching proportion has reacted with beneficial effect upon the universities, and has tended to promote scientific thought throughout the land. By its demonstration of the practical importance of purely theoretical conceptions, it has had a far-reaching effect on the intellectual life of the nation. How much such a scientific revival is wanted in our own country the social and economical history of the past ten years abundantly testifies. For in the struggle for existence between nations the battle is no longer to the strong in arm, but to those who are the strongest in knowledge to turn the resources of nature to the best account.

In 1886 it could perhaps still be maintained that we held the key to the situation if we chose to make use of it; inasmuch as the principal raw products of the color industry (tar oils, naphthalene, anthracene, soda, ammonia, iron, etc.) were in great measure imported from England. In 1878 Professor von Bäyer had said: "Germany, which in comparison with England and France possesses such great disadvantages in reference to natural resources, has succeeded by means of her intellectual activity in wresting from both countries a source of national wealth. The primitive source of this wealth is in England. It is one of the most singular phenomena in the domain of industrial chemistry that the chief industrial nation, and the most practical people in the world, have been beaten in the endeavor to turn to profitable account the coal-tar which they possess. We must not, however, rest upon our oars, for we may be quite sure that England, which at present looks on quietly while we purchase her tar and convert it into colors, will unhesitatingly cut off the source of supply as soon as all technical difficulties have been surmounted by the exertions of German manufacturers."

But the initial advantages which our natural resources afforded us have been neglected, and now, in 1901, the conditions are completely changed, and Germany is no longer dependent upon England for her raw material. Through the shortsightedness, ignorance, and want of enterprise of those with whom rested the care of the color industry of this country in its earlier days, the opportunity has been allowed to pass forever. The English manufacturer considered that a knowledge of the benzene market was of far greater importance than a knowledge of the benzene theory, and little encouragement was given here to chemical investigators and discoverers. The control of the industry passed into the hands of men who had no knowledge and absolutely no appreciation of the science upon which their business rested, and concerned only with getting the ultimate amount of present profit, discouraged all scientific investigations as waste of time and money. The chemist who devoted himself to the elucidation of the chemical constitution of a coloring matter was regarded by them as an unpractical theorist of no value to a manufacturing business. Even when he discovered new coloring matters of commercial value, they were so blind to their own interests and so incapable of believing that any practical good could come out of such theoretical work, that in many cases they refused to patent or in any way take advantage of the discoveries made by him.

During recent years this attitude has certainly undergone considerable modification. Certain firms must indeed be given the credit of endeavoring to pursue a more enlightened policy, but these attempts have always been directed too much in the expectation of realizing immediate financial results. The difficulties which must be encountered in an attempt to regain the lost ground are of necessity very great and quite unappreciated by our business men. It seems, in fact, to have been the opinion of the public and of the average financial man that this industry ought to be easily won back by the establishment of a few technical schools, the engagement of a dozen chemists, and the investment of a few thousand pounds in new plants, forgetting that the supremacy of our German competitors has been won by years of patient toil, by the work of hundreds of trained chemists, and by the outlay of millions of capital. Who can be surprised, therefore, if such expectations have not been realized, and if in spite of some notable successes the general position of the color trade in England to-day presents a gloomy aspect?

Where, then, are we to look for an improvement? Some would find a remedy in the imposition of heavy protective tariffs, but such tariffs in France have not availed to prevent a similar state of things there, and protection in coloring matters might have a very detrimental effect upon the textile industries of the country. Others expect salvation from the extension of technical schools, but laudable as is the aim of these institutions, I cannot see how they can effect much until their raw material is of a very different character from what it is at present, and until the public can be completely disabused of the fallacy that a year or two of technical training pumped into an ignorant schoolboy will produce a better works-chemist than a university course of scientific study laid upon the foundation of a good general education.

The remedy for the present state of affairs must of necessity be a slow one, and in my opinion can only be found in a better appreciation of the value of science throughout the length and breadth of the land. Until our government and public men can be brought to realize the importance of fostering the study of science, and of encouraging all scientific industries, until our schools and universities appreciate the importance of a scientific education, until the rewards for public service in science are made equal to those in other branches of public service, so long will science continue to be held in insufficient esteem in our country. It is not so much the education of our chemists which is at fault as the scientific education of the public as a whole.

When our capitalists more completely realize the importance of calling in the aid of the best scientific skill available, when our universities and technical schools are able to supply a sufficient number of highly educated chemists equal in knowledge, originality and resource to those trained in German universities, when our professors and manufacturers are willing to work together in this and other matters, when our patent laws are rendered just to ourselves, we may confidently hope that our natural engineering skill and practical resource will once more bring us to the front.

CONCERNING CERTAIN MOSQUITOES.

DURING the season of 1901 the writer studied the mosquito problem, as it exists in the State of New Jersey, with a view to determining whether it was possible in any way to reduce or control the number of these pests in the State. It was decided that the first point of importance was to ascertain just what species was or were the most troublesome, and just where these troublesome species bred. Collections were made in all parts of the State and local boards of health were enlisted in the service everywhere. The result was the accumulation of a large amount of material, covering every county and almost every district in the State.

Based upon these collections, it was found that the most abundant species was *Culex sollicitans*, and, after this fact was determined, especial attention was paid to the life history and breeding places of this mosquito. It has been known that the species breeds in brackish water; but it has been believed, and is so stated by Dr. Howard in his book on mosquitoes, that it would not breed in water as salty as the sea itself. Collections made along shore soon proved that this general belief was incorrect: so far as noted the contrary is true, for larvæ were found in great abundance in pools and ponds in which the water was fully twenty-five per cent. more salty than ordinary sea water. The collections in the marshes along the coast demonstrated that some percentage of salt was absolutely necessary for the development of the larvæ. In no case were they found in fresh water, even where adults occurred in enormous quantities. This was prettily illustrated on the Elizabethport meadows, from which the cities of Newark and Elizabeth get the greatest proportion of their mosquito supply during the summer. A large portion of these meadows is flooded during extra high tides, or during storms; a number of fresh water creeks run through them and rapidly freshen these salt-water-covered areas. This is especially true during the latter part of the summer after a period of moderate tides. A two days' collecting trip by an assistant failed to develop any larvæ of *sollicitans* until the shore edge of the meadows was reached, where the puddles were distinctly salty. Everywhere else, while there were plenty of other larvæ discoverable those of *sollicitans* were entirely absent. After a heavy storm causing an unusually high tide, which flooded the meadows, collections were again made and now, as salty water was found almost everywhere, there was no difficulty in obtaining larvæ of *sollicitans*. Every attempt was made to secure *sollicitans* larvæ from fresh water; but almost without success, even where the insects occurred in swarms. I feel no hesitation in claiming that under natural conditions the larva of this species is never found in fresh water; unless it is in a pool that was salty when the eggs were laid and has been freshened subsequently by rains, or otherwise.

Another fact was established by observations made during the summer: that is, the species will travel long distances from its breeding places. For miles throughout South Jersey the only species of mosquito found in any numbers is *Culex sollicitans*. On the cranberry bogs on which I spent some time countless thousands of these insects occurred. The breeding conditions for mosquito larvæ were almost ideal and plenty of larvæ were found, but none were of this species. All the specimens observed were females; males apparently do not go away from their natural breeding places. Twenty miles back from the coast, *sollicitans* is the dominant species and occurs most of the summer. Forty miles from the coast occasional flights occur; but their period is short, rarely lasting more than a week or ten days, and there may not be more than one or two of them during the season. From observations made and information gathered along shore and back from it for some distance, it seems certain that large swarms rise during favorable evenings and are carried during the night by the wind for varying distances. The direction is determined by the direction of the wind, and may be as often out to sea as inland. Swarms have been met with fifteen miles from shore, and are common five miles from shore. These are usually if not always lost. This migration, if that term can be properly employed, is contrary to previous beliefs, my own included, and is an important factor in the question of the control of mosquitoes in the State. It takes it out of the rank of local problems and makes it a State affair. It is quite obvious that no methods adopted at a point where these mosquitoes do not breed can prevent their abundance when the wind is in the right direction to bring swarms of them from the sea coast. On the other hand, there seems to be no very great difficulty in deciding upon the character of the work that should be done to destroy the breeding places of these pests. The measures are largely of a permanent character. They consist partly of draining, partly of ditching and partly of opening ways for the free entrance of tides, and with them of certain species of small fish that feed on mosquito larvæ. At a comparatively small expense considerable areas can sometimes be freed of breeding places. Much has been done by private enterprise at seashore resorts and there will be no difficulty in securing cooperation in any work that the State may undertake or may suggest.

The next species in abundance is *Culex pungens*. The history of this species has been so well written that little remains to be added to it. It is the one species of *Culex* of which we know positively that it hibernates in the adult stage. It breeds everywhere in almost all sorts of places, provided only there is water which is not salty. I have never found it in salt water; but in other respects it is not particular. It breeds in cesspools, sewage water and even in manure pits. It has no objection to remaining indoors, and the larvæ will swarm in a neglected bucket just as readily as they do in a half-filled tin can on a dump. The only point of particular interest noted in connection with this species is the fact that it breeds much later in the season than has been believed. Active larvæ were found until late in November, and even less than half-grown forms were seen at that time, indicating a comparatively recent oviposition. As against this species local work is necessary and effective; but it is far from necessary to treat indiscriminately all sorts of bodies of water. There are some places where even this insect will not breed, and unless information is generally distributed concerning the places that actually need treatment, a good deal of work will be wasted and unnecessary expense incurred.

Some very interesting information concerning the species of *Anopheles* has been gathered. It has been known that these species hibernate as adults; the places where they hibernate in the woods have been discovered; the general character of the breeding places has been established and it has been found that the larvæ may be found in salt water as well as fresh. This has been asserted of a European species but was doubted by Dr. Howard for our own. It has been also found that these insects continue to breed until long after frost has set in. Larvæ and pupæ were taken from ponds that had been completely ice covered. On at least three separate occasions adults were bred from larvæ and pupæ after they had been confined in or under ice for a period of several hours. It is demonstrated beyond peradventure that mere cold or even an ice covering is not fatal to larval or pupal life of *Anopheles*. It is further indicated from the researches made that there is absolutely no connection between the abundance of *Anopheles* and the prevalence of malaria. In a limited district where malaria as an original disease is unknown, over two thousand specimens of *A. punctipennis* were taken from the cellar under a moderate-sized farm-house. From the outbuildings as many more were captured, in October and November. Altogether about this one group of farm buildings fully five thousand specimens were actually taken during the two months mentioned. This is, therefore, one of their commonest mosquitoes; yet patients afflicted with malaria have come there, away off in the woods, to get well; and they did so, without leaving in their trail a wake of malarial cases. I do not wish to be understood as doubting the connection between *Anopheles* and malaria, nor that the mosquito is necessary as an intermediate host in the development of the pathogenic organism. I wish only to say that my investigations point to the fact that there is some other factor involved and that, even in the presence of an existing case of malaria, *Anopheles* is not able to transmit the disease to a healthy individual, unless certain other conditions favor the transmission or the development of the malarial organism after it is introduced into the healthy subject.

JOHN B. SMITH.

RUTGERS COLLEGE,
Dec. 6, 1901.

UNIVERSITY REGISTRATION STATISTICS.

A knowledge of the present condition of the status of higher education in the United States may be gleaned from the accompanying table, wherein are enumerated statistics relating to the registration at seventeen of the leading universities in the country, both East and West. These figures have been obtained from the proper officials of the institutions concerned, and are as correct as statistics of this nature can be made. With but slight exceptions, these figures are approximately as of November 1, 1901.

	California.	Chicago.	Columbia.	Cornell.	Harvard.	Indiana.	Johns Hopkins.
College Arts, Men	2099 (49)	494 (54)	481 (17)	817 (73)	1983 (—9)	660 (100)	163(—15)
College Arts, Women		535	326 (34) §		452 (3) ‖	385 (65)	....
Scientific Schools *		....	601 (61)	1017 (134)	549 (42)	....	....
Law	100 (—21)	....	441 (14)	197 (21)	628 (—19)	135 (10)	....
Medicine	161 (—10)	257 (?)	800 (49)	415 (79)	506 (—99)	....	227 (16)
Agriculture	†	....	....	86 (—5)	32 (—1)	....	....
Art	178 (—30)	....	....	....	....	....	....
Dentistry	141 (—11)	....	....	....	105 (—21)	....	....
Divinity	....	192 (12)	....	....	37 (9)	....	....
Forestry	....	....	....	38 (16)	....	....	....
Music	....	....	....	....	....	....	....
Pharmacy	85 (1)	....	....	....	....	....	....
Teachers College	‡	95 (?)	526 (78)	....	....	....	....
Veterinary	....	....	....	51 (10)	....	....	....
Graduate Schools	168 (13)	404 (74)	472 (60)	183 (—9)	312 (—29)	51 (11)	169 (9)
Courses for Teachers	....	....	400 (—279)	....	....	50 (?)	....
Summer Session	799 (366)	1750 (—40)	579 (162)	424 (—21)	982 (—5)	453 (120)	....
Other Courses	....	....	18 (—2)	....	....	233 (?)	97 (16)
Deduct double regist.	[191]	[?]	[222]	[?]	[10]	[?]	[1]
Grand Total	3540 (319)	3727 (—47)	4422 (225)	3216 (313)	5576 (—148)	1967 (?)	655 (25)
Teaching Staff	250	202	466	387	495	78	139

* Includes schools of engineering, chemistry, architecture, mines and mechanic arts.

† Included in scientific schools.

‡ Included in college.

§ Barnard College.

‖ Radcliffe College.

The gain or loss in the enrollment in the various departments of the universities enumerated are indicated in each instance, where obtainable, by figures within parentheses. These figures have been revised, and may not tally exactly with the figures to be found in Science published on December 21, 1900. The enrollment figures for the University of Nebraska are for the first time included in this table.

While statistics of this character may not be exactly the same for two weeks in succession, as those engaged in university administrative work well know, nevertheless such figures are general enough in import to indicate the trend of the advancement of higher education in various sections of the country. Changes in curricula, stiffening of entrance requirements, and the inauguration of new policies, materially affect the enrollment statistics of any university.

Particular attention is called to the effect of the introduction of the new entrance requirements to the Harvard Medical School. The demand of four years' liberal training in a college previous to entrance upon the work of the Harvard Medical School has resulted in a loss of almost 100; but this change will inevitably result to the advantage of the Harvard Medical course.

Attention is also called to the increased enrollment in the summer sessions of both our eastern and western universities.

While there has been a falling off in the grand total of attendance on some of the universities tabulated, there has at the same time taken place a steady forward movement in the progress of higher education, as revealed by these statistics of attendance.

GEO. B. GERMANN.

SCIENTIFIC BOOKS.

Die Entwicklung der Biologie im 19. Jahrhundert. Vortrag auf der Versammlung deutscher Naturforscher Zu Aachen am 17. September, 1900, gehalten von OSCAR HERTWIG. Jena, Gustav Fischer. Pp. 31.

Leland Stanford.	Michigan.	Minnesota.	Missouri.	Nebraska.	Northwestern.	Pennsylvania.	Princeton.	Wisconsin.	Yale.
675 } (—71)	655 (17)	489(—2)	} 456(?)	374	323 } (—15)	453 (32)	773(28)	} 869	1236(44)
432 }	598 (7)	638(46)		533	272 }	....	....		....
*	472 (119)	439(78)	417(?)	369	....	355 (19)	466(38)	639	624(14)
*	821 (12)	490(27)	137(22)	145	175 (0)	376 (32)	....	245	246(36)
....	474 (—43)	386(29)	86(4)	14	408 (4)	538 (28)	....	......	148(15)
....	....	605(61)	53(—35)	58	64 (5)	....	....	18	....
....	....	....	....	38	....	....	....	......	66(—9)
....	200 (—78)	104(—2)	....	......	541 (51)	361 (54)	....	......	....
....	....	....	....	......	155 (0)	....	....	......	98(9)
....	....	....	....	......	....	....	....	......	30(23)
....	....	....	....	238	261 (60)	....	....	108	69(—57)
....	62 (—7)	73(3)	....	......	184 (20)	....	....	30	....
....	....	....	123(64)	......	....	....	....	......	....
....	....	....	....	......	....	72 (15)	....	......	....
73 (—11)	93 (17)	170(—7)	39(4)	86	....	180 (10)	123(45)	115	329(30)
....	....	....	....	......	....	185(—45)	....	......	....
48 (—8)	418 (14)	302(27)	507(68)	256	....	....	....	375	....
....	64 (—10)	....	....	21	....	0(—10)	....	466	....
[?]	[41]	[160]	[269]	[229]	[18]	....	....	[53]	[166]
1228 (—90)	3816 (64)	3536(113)	1549(214)	1903	2365 (125)	2520(—29)	1362(111)	2812	2680(178)
164	239	260	?	?	244	270	90	170	290

* Included under College. 170 students in law are enrolled; loss of 15.

The advancement in knowledge of organic nature was so remarkable during the nineteenth century that it is of unusual interest to have the progress in biology summed up by one of the leaders in the movement. As might be expected from Hertwig's well-known powers of clear exposition, the reading of this lecture is enjoyable; the line of thought is not difficult to follow and the analysis of the subject is as simple and direct as it is possible to make it within the limits of thirty-one pages. It is, of course, impossible in many instances to do more than suggest the line of influence of a group of men whose work has been of epoch-making importance. The names of most of the great leaders are mentioned categorically—and the list is a long one, but it is a disappointment to miss any reference to Bichat. His influence was so considerable on the development of minute anatomy in the nineteenth century that, notwithstanding the fact that he met his early and untimely death in 1802, his should be recognized as one of the great influences in the development of biology in the nineteenth century. The omission of the name of any American investigator is more in the nature of a blunder. However clear the general account of biological progress may be, it is inadequate if no place is found in it for such names as Cope, Marsh and Gray or for the mention of the embryological and cytological researches of American investigators.

The subject is naturally considered under two main divisions—the progress in morphology and that in physiology. In regard to progress in morphology, the four following factors are indicated as having had the greatest influence: (1) The establishment of the cell theory and the closely related protoplasm doctrine. (2) The development of the science of bacteriology. (3) Progress in embryology. (4) The doctrine of organic evolution.

The great influence of the cell theory is especially emphasized, not only as to its unifying tendency in uniting animals and plants on the broad basis of similitude of structure, but also as opening to naturalists the real problems of the living organism. The discovery that fermentation, putrefaction and finally, that many diseases are due to micro-organisms, stimulated studies which led to the establishment of the science of bacteriology. The revival in the nineteenth century of the question of spontaneous generation is mentioned, and the great triumph of Pasteur in demonstrating the falsity of the position of the heterogenists. Here also one notes another omission—no reference is made to the luminous researches of Tyndall on this subject with optically pure air. The great influence of embryology as founded on the work of Pander and von Baer is sympathetically although briefly treated. The facts that all animals begin as single cells, and show every gradation between that simple condition and the more complex one of the adult, and that ontogeny is in a sense an epitome of phylogeny, are sufficiently striking to endue this subject with unusual interest. Lastly, the influence of the establishment of the theory of evolution is spoken of.

In physiology the fundamental importance of experiment is pointed out—what the microscope is for anatomy, experiment is for physiology. Among the greatest advances mentioned in the first half of the century are the demonstration of Bell's law and the elaboration of the theory of specific energy by Johannes Müller. The development of physiology along the respective lines of chemical and physical physiology is discussed, together with the opposition aroused by these researches to the old theory of vitalism. The observations as to the action of chemical substances within the bodies of lower animals were turned to practical account in medicine. While physiology was being developed along chemical lines by one school, represented by Claude Bernard Pettinkofer, Voigt, Pflüger, Heidenhain and others, it was being advanced along physical lines by Robert Meyer, Helmholtz, Ludwig, Dubois-Reymond and others. With the latter school came exact methods of measuring and recording physiological activities, as with the kymograph, myograph, etc. The greatest triumph of the chemical and physical methods was in demonstrating that physiological processes are chemico-physical rather than vital. But this conception has been carried too far; some physiologists look upon life, with all its complex manifestations, as being entirely chemical and physical. This is as far wrong as the old theory of vitalism. The relation of the physicist to biological questions is similar to that of the chemist. Physiological questions can not be explained on purely chemical and physical grounds. We can not find out the rôle played by albumin in vital processes by study of its chemistry, but by direct study of the protoplasm in living cells. We must return to an anatomico-biological basis and let it be modified by the chemico-physical conception. The material world must be united by biological studies with the manifestations of the immaterial world of life.

William A. Locy.

Comparative Physiology of the Brain and Comparative Psychology. By Jacques Loeb. The Science Series. New York, G. P. Putnam's Sons. 1900. Pp. x+309. $1.50.

Professor Loeb's book forcibly calls attention to the importance of the comparative method in physiology and psychology. The present work is a translation, with additions and changes, of the German edition of 1900 by Mrs. Loeb. The book has been made into English with singular skill. It is clear, concise, scientifically accurate in statement, and, withal, readable. Of it may truthfully be said 'every words counts.' Whether one agrees or disagrees with any or all of the conclusions reached, the discussion is valuable, for it pleads for opposition, contradiction, investigation. There are not so very many physiologists, we fancy, who will fully agree with all the theories which Professor Loeb seeks to maintain; fewer still are the psychologists who will find themselves in sympathy with his attitude, and among ethical thinkers scarcely any will come to the support of the new scientific construction whose possibility, nay, necessity—for our author is evidently a man of strong convictions—is hinted at. But opposition is needed for the testing of the theories in which the book abounds, although we doubt not that in the main the author's position is a safe one. Nothing is clearer than the seriousness with which Professor Loeb takes himself and his work. Every sentence indicates that he realizes the importance of the study of life phenomena, and appreciates the intimate relationship of all physiological investigation to the practical problems of our work-a-day life.

The book is itself a collection of experimentall discovered facts of neural physiology so arranged that they inevitably lead the reader to the definite conception of the rôle of the nervous system held by the author. Noteworthy is the fact that a majority of the experimental studies from which evidence is drawn in support of the views presented have been made by Professor Loeb himself. They form, as thus gathered together, and unified by a single purpose, a splendid monument to the energy, patience and enthusiasm of a physiologist who has well earned the praises of the scientific world. To say of most physiologists 'he has based a general discussion of the function of the nervous system solely upon the results of his own researches,' would be equivalent to characterizing and condemning the work as narrow and incomplete. But of the work in question this cannot be said, for Professor Loeb's investigations have covered such a wide range of physiological andpsychological phenomena, and his problems have been selected with such rare insight into the general implications and relative importance of different aspects of his chosen work, that they furnish an excellent foundation for the theories which he presents.

The conscious and avowed goal of Professor Loeb's researches is 'the control of life phenomena.' His slogan well might be 'more life and fuller that we want.' It is not simply to understand the functions of the organism for the sake or satisfaction of understanding, but that we may be the better able to regulate our lives that we should strive toward the control of vital processes. Toward this goal we are to progress by the use of the methods of physics and chemistry. To quote, "It seems to me that living organisms are machines and that their reactions can only be explained according to the same principles which are used by the physicist." On the basis of the physical and chemical qualities of protoplasm our author proposes to explain all activities.

'Comparative Physiology of the Brain and Comparative Psychology' may for review be divided into four parts. Of these the first deals with the relation of reflex action to the nervous system. Experimental evidence is presented to prove that such actions are not dependent upon any specific character of nerve tissue, but upon the general properties of protoplasm. This is followed by a consideration of the morphological and physiological evidence bearing upon the 'center theory' and the 'segmental theory' of the nervous system, with a defense of the latter. The third main subject is the relation of instinctive action to the rôle of the nervous system and to reflex action. Experiments are cited to show that the instinctive act is really only a chain of reflexes. Finally, in the portion of the book which comes under the title 'comparative psychology,' associative memory is pointed out as the psychic fact of prime importance. Its connection with brain functioning is discussed, and the possibility of analyzing all complex psychic phenomena into associative processes maintained.

It is common to refer all actions to nerve centers. Even the simplest reflex act is thought of by many as dependent upon the functioning of a ganglionic center. Now it is Professor Loeb's conviction that this is an erroneous view; and by an examination of experimental studies of representatives of the Cœlenterata, Echinodermata, Vermes, Arthropoda, Mollusca and Vertebrata he proves that reflexes can be executed in the absence of ganglia. A few of the instances mentioned in the book may be cited.

Study of the Medusæ has shown that the bell will make normal spontaneous, coordinated movements after the nervous system has been removed. Thus by a very simple experiment, spontaneity, coordination and reflex action are proved to be independent of the central nervous system.

Among the Ascidians, *Ciona intestinalis*, whose nervous system consists of a single ganglion, normally exhibits a peculiarly characteristic reflex in the closing of both the oral and aboral openings, when open, if either is touched. If the ganglion be removed the animal will still carry out this reflex. But careful study shows that there are differences between the action of the normal animal and the one which lacks its ganglion. In the latter the threshold of stimulation is higher and the reaction-time greater. From this Professor Loeb concludes that 'the nerves and ganglion only play the part of a more sensitive and quicker conductor for the stimulus.'

The tentacles of *Metridium* in the food-taking activity of the animal move in such a way as to bring the object with which they are in contact to the mouth. The action is one of apparent adaptation, and one would scarcely expect to see the same kind of a reflex occur after the tentacle had been cut from the body. Such, however, is the result of the experiment; no difference between the action of the tentacle in normal relation to the nervous system and that which has been isolated is observable. We have to conclude, therefore, that the action is determined by the properties of the protoplasm of the tentacle itself, and not by special properties of the nervous tissues.

Other observations prove that certain worms when deprived of their brains are able to move spontaneously. As a case in point, the freshwater Planarian, *Planaria torva*, is sensitive to stimulation by light. To any increase in intensity it responds by movement. It also selects the darkest region of a dish in which it is left. When the anterior portion of the body is cut off it is found that the brainless portion will give the same responses to light as the normal animal. And the only significant fact in favor of the influence of the brain upon such activities is that the reaction-time of the brainless animal is longer.

Of the reflexes of higher animals that are known to be in part at least independent of the brain and cord are the movements of the iris, the bladder, rectum, blood vessels, respiratory organs, etc. Experiments upon fishes, frogs and dogs have established the independence of many of their reflexes. In one instance the whole brain and spinal cord of a larval frog were destroyed without interfering with spontaneous movements. There are so many observations of this kind for the vertebrates that one cannot question the general truth of Professor Loeb's conclusion. As he states, those instances in which the reflex is interfered with by the destruction of the nervous system are explicable by the fact that the only existing connection between the sense organ and the muscle has been broken. Establish any kind of protoplasmic connection between the region in which the disturbance arises and the motor apparatus, and the appropriate reflex will be executed.

But the fundamental experiment for the proof of the independence of reflexes is that made by Professor Loeb upon isolated muscles. He has shown that muscles containing no ganglion cells will beat rhythmically when placed in a pure sodium chloride solution of the same osmotic pressure as the blood. To put the matter in his words, "It is not the presence or absence of ganglion cells which determines the spontaneous rhythmic contractions, but the presence or absence of certain ions. Na ions start or increase the rate of spontaneous rhythmical contractions; Ca ions diminish the rate or inhibit such contractions altogether." Now it is clear that to prove the isolated muscle capable of responding to stimuli is to establish the thesis which has been stated.

The conception of the nervous system as a series of more or less intimately related centers, each with its own special function, arose and found an observational basis in the many experiments on localization. Certain parts of the brain apparently control certain groups of muscles. This is undoubtedly true, but Professor Loeb attempts to show that the conception as a whole is false. From comparative morphology and physiology comes abundant evidence of the segmental theory of the nervous system. In the Annelids, for example, the segments, each with its ganglion and nerves, are to a certain extent independent organisms. Each ganglion in this case functions in connection with a very definite portion of the worm.

"The so-called centers of the cerebral cortex are merely the places where the fibers from single segments of the central nervous system enter." If the spinal cord of a dog be cut it will be found, after the shock of the operation has passed, that all of the reflexes belonging to the segments of the body which are represented by the portion of the cord severed can be executed. Rubbing of the skin causes scratching movements of the hind legs, and the reflexes of bladder, rectum and respiratory organs occur in response to the appropriate stimuli.

"According to the segmental theory," writes our author, "there are only indifferent segmental ganglia in the central nervous system, and the different reactions or reflexes are due to the different peripheral organs and the arrangements of the muscles. The center theory must remain satisfied with the mere problem of localizing the apparent 'seat' of a 'function' without being able to give the dynamics of the reactions of an animal, as the latter depend in reality upon the peripheral structures, and not on the structures of the ganglia. For this reason the segmental theory alone will be able to lead to a dynamical conception of the functions of the central nervous system."

In taking up the problem of instinct Professor Loeb touches a field which he has made distinctively his own; for no one has done so much as he toward the analysis and explanation of this type of action. He holds that there can be no sharp separation of reflex action from instinctive. The reflex usually is the activity of a single organ, and the instinctive act one in which the whole organism is concerned. Instinctive actions are characterized by an apparent adaptation to a special purpose, an adaptation to the circumstances in which they occur. For this reason there is a strong tendency to regard them as results of intelligence. For years Professor Loeb has been studying, and, as it were, dissecting, instinct after instinct in order to show the absurdity of this conception.

The fly that instinctively selects for the depositing of its eggs a substance on which the larvæ can feed does so not because it has a faint notion of the utility of the action, or even because it chooses so to do, but because the chemical particles emanating from the substance stimulate it in such fashion as to cause an orientation of its body in reference to the source of the stimulus, and this orientation in turn determines the movement toward the substance. The whole is simply a mechanical problem; physics and chemistry serve to explain the instinct.

An insect comes within the range of vision of a frog and is instinctively stalked, seized and swallowed. In this event the visual stimulus initiates a series of reflexes whose result is the obtaining of food. There is no deliberate choice, no intelligence in the action. The crustacean or insect or worm that instinctively moves toward a source of light does so, experiments indicate, simply because the light forces it to take a certain orientation, just as the chemical stimulus did in case of the fly. Once having taken this position, there is only the possibility of moving toward the source of the stimulus. The 'orientation theory' is one of Professor Loeb's chief contributions to the explanation of instincts. It is based upon the assumption that when a stimulus affects symmetrical points of an animal's body unequally there is resulting inequality of muscular activity on the two sides, and as a result the organism is finally forced into that position in which symmetrical points are equally stimulated. Such a position is evidently attained when the long axis of the body is parallel with the rays of light, for example, with the head either toward or away from the source of the light. From this position it is clear the animal can move only toward or away from the light.

And again it is noticed that certain arthropods and worms 'hide' in crevices. If we study this action we learn that the animals are able to remain quiet only when the body is in contact with some object, and so long as it is not in such a position the animal moves about continuously. In the act 'hiding' plays no part. The phenomenon is merely the inhibition of movement by a stimulus, it matters not whether the stimulus be given by a board which really 'hides' the animal or by a plate of glass which leaves it fully exposed to view. And so one might go on with the enumeration of simple instinctive acts that appear to be guided by reason, but whose careful study reveals only the influence of certain environmental factors upon a definitely describable organic structure.

To the most important of these environmental factors the name 'tropism' has been applied. Heliotropism is the response to light; chemotropism, to chemicals; galvanotropism, to electricity; stereotropism, to contact; geotropism, to gravity; hydrotropism, to moisture; thermotropism, to temperature, etc. All simple instinctive acts are found to be responses to one or more such factors either external or internal; those more complex actions of which nest building and the instinctive processes of ants, bees and wasps are representative are presumably due to a number of factors working simultaneously and giving rise to a series of reflex acts, the whole of which in their interconnection is an instinctive action. No one has yet succeeded in satisfactorily analyzing any of these complex activities, but Professor Loeb has confidence that the subjecting of any of them to laboratory requirements will reveal the same kind of structure as has been discovered in the simple acts.

The chapter on instinct closes with some remarks concerning the relation of the conception presented to ethics. "The analysis of instincts from a purely physiological point of view will ultimately furnish the data for a scientific ethics. Human happiness is based upon the possibility of a natural and harmonious satisfaction of the instincts." Such are the significant statements with which we are introduced to the author's ethical philosophy. From the naturalistic point of view ethics can have no other foundation than that indicated above; and there is no doubt that he who is only a physiologist can find complete satisfaction in it. But one feels, *instinctively*, that Professor Loeb, despite his unpleasant, though appropriate, introductory words concerning the mixing of metaphysical and scientific conceptions, is of a philosophic mind, and it seems probable that physiology alone saved him from becoming a technical metaphysician.

We find upon turning to the discussion of comparative psychology that Professor Loeb considers as the central and chief problem of the physiology of the central nervous system the study of the 'mechanisms which give rise to the so-called pyschic phenomena.' As the elemental psychic fact he names 'associative memory,' by which he means neither more nor less, so far as we can see, than what the psychologist designates as an associative process. Wherever associative memory is found there is material for the psychologist. His first task must be to determine in what animals this psychic phenomenon occurs, and his second, to analyze the more complex processes of higher animals into the elements of the psychic process, much as the instinctive act is analyzed into reflexes.

An animal which can learn is said to have psychic processes. In this criterion of associative memory is seen, by Professor Loeb, the basis of a future comparative psychology. Among vertebrates it is well known that associative processes are found; even the Amphibia and Fishes profit by experience, although it is stated by the author that the frog has not yet been proved to have associative memory. Of the invertebrates in this respect little is known for they have not been studied experimentally. But at present it seems safe to say the Cœlenterata and Vermes are not known to profit by training. By this criterion of the psychic a very sharp limit for the field of psychology is indicated. Those who do not believe in what Professor Loeb describes as crises in development will not be likely to take much stock in his conception of the rôle of comparative psychology until experimentation has proved the abrupt appearance of the associative process in the animal series. For until then there will remain the possibility that the whole thing is a matter of degree of ability to profit by experience, rather than of the presence or absence of a brain mechanism which is able to mediate the association. On this point the author says, "The idea of a steady, continuous development is inconsistent with the general physical qualities of protoplasm or colloidal material. The colloidal substances in our protoplasm possess critical points."

Two chapters of great interest treat of the 'Cerebral Hemisphere and Associative Memory' and 'Anatomical and Psychic Localization.' Concerning the valuable experimental data furnished in them we may make only a general statement. It proves that the associative process in vertebrates is dependent upon the cerebral hemisphere. "The assumption of 'centers of association,'" says the author, "is just as erroneous as the assumption of a center of coordination in the heart. Association is, like coordination, a dynamical effect determined by the conductivity of the protoplasm. Associative processes occur everywhere in the hemispheres (and possibly in other parts of the brain), just as coordination occurs wherever the connection between two protoplasmic pieces is sufficient. It is just as anthropomorphic to invent special centers of association as to invent special centers of coordination."

Finally, attention should be called to the stress which in this valuable contribution to the literature of comparative physiology is laid upon the chemical and physical study of protoplasm and its transformations. Ultimately it would appear all physiological investigations resolve themselves into problems of the physics of colloidal substances.

In this imperfect and inadequate review of Professor Loeb's book an attempt has been made to indicate a few of the general tendencies and conclusions which seem of prime importance. There are a large number of interesting experimental studies discussed in the book which have not even been mentioned here. We have taken the liberty to quote freely from the text, and it is hoped that the sentences thus selected to indicate the author's point of view will in no case misrepresent him because of their isolation.

ROBERT MEARNS YERKES.

CAMBRIDGE, MASS.

Plant Life of Alabama. An account of the distribution, modes of association and adaptations of the flora of Alabama, together with a systematic catalogue of the plants growing in the State. By CHARLES MOHR, Ph.D. Contributions from the U. S. National Herbarium. VI. Washington. 1901. 8vo. Pp. 921. 12 plates and 1 map.

The 'Plant Life of Alabama' is a noteworthy addition to the list of works which treat of State floras. The book consists of two parts; one, of 127 pages, dealing chiefly with the floristics of the vegetation, the other, of 708 pages, containing a complete catalogue of the flora. The first part will be particularly welcomed by phytogeographers as the first serious analysis of a portion of the vegetative covering of the southeastern United States. The value of this portion lies chiefly in the observations and lists which it contains, as no systematic investigation of the vegetation has yet been made. The absence of recent methods and the lack of detailed formational analysis detract much from this part, though the lapse of time between the completion of the manuscript and its publication would seem to indicate that this is not the fault of the author. It is much to be regretted that the author's death occurred before his book finally appeared.

The author sketches the history of the botanical exploration of Alabama, giving a brief account of the labors of Bartram, Peters, Buckley and others. This is followed by a summary of the general physiographical and climatic features of the State. Physiographically, the area considered falls into five regions, the coastal plain, the region of crystalline rocks, the region of the coal measures, the Coosa Valley and the Tennessee Valley. The author gives a brief discussion of the general principles underlying plant distribution, in which he has unfortunately made use of Merriam's divisions of the North American continent, which are phytogeographically incorrect. The formational treatment is based upon the work of Willkomm and Warming. The accurate classification of formations, however, as hydrophytic, mesophytic or xerophytic, is hardly to be determined otherwise than by actual physiometric investigation of formations, which have been tentatively determined by means of floristic. The formational analysis of the vegetation is neither close nor thorough, consisting for the most part of floristic lists of the various habitats, with very slight consideration of the interrelations of the species which constitute the formation. In some instances (page 65) the difficulty seems to rise from the fact that the acquaintance with the particular vegetation is at second hand.

Under biological and ecological relations, the author treats briefly of the forest flora, in which are included shrubby-plant associations and arboreal-plant associations, evergreen and deciduous, the campestrian flora, the water and swamp flora, including the hydrocharidean, lithophytic, limnæan and palustrian classes, and of the organotopic flora, comprising epiphytic, saprophytic, symbiotic and parasitic plant associations. This is followed by an interesting discussion of introduced plants, which are regarded as naturalized, adventive and fugitive. The more detailed consideration of the vegetation is taken up under plant distribution, in connection with the Carolinian and Louisianian areas. In delimiting the two the author makes use of 'truly zonal plants,' which, except in restricted formations, usually of hypdrophytic stamp, are illusive. The Carolinian area falls into the mountain region, the table-lands, the region of the Tennessee Valley and the lower hill country. Under each is given a summary of the physiographical features and climate, and a discussion of the various formations, grouped as xerophile and mesophile forests, and xerophile, mesophile and hydrophytic plant associations. The Louisianian area is likewise divided into several regions, central pine belt, central prairie, maritime pine and coast plain, in which the treatment of the formations is similar.

Notwithstanding the valuable information now made available for the first time in the part just considered, the second part is a more important contribution. It contains an excellent catalogue of the entire flora, in which are enumerated more than 4,500 plants, of which 2,500 are flowering plants and upward of 2,000 cryptogams, numbers which indicate an extreme richness and diversity of vegetation. The large list of fungi, which is contributed by Professor Earle, is a testimony of the energy and industry of a few workers, notably Peters, Atkinson, Underwood and Earle. The algæ are apparently little known as yet, a fact which explains the preponderance of anthropytes in the list. The entries of the flowering plants are models of floristic cataloguing. The bibliography is full, and indications of range, both State and continental, are given with unusual care. The type locality is indicated wherever known, as is also the disposition of the Alabama exsiccati. Altogether the catalogue is the most complete and painstaking State list so far contributed to American botany. The book closes with a list of the plants cultivated in Alabama, a tabular statement of the plants of the State, and a very satisfactory index.

Frederic E. Clements.

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TWO PAPERS ON ANIMAL MECHANICS.

Ueber die Bewegungen in den Handgelenken, von Rudolf Fick; *Ueber die Bewegungen des Fusses u. s. w.*, von Otto Fischer; both in the 26th volume of the Abhandlungen der Math. phys. Classe der König. Sächsischen Gesellschaft der Wissen., Leipzig, 1901.

These papers are alike, but in some respects quite different. In the former Fick discusses the movements of the bones of the wrist as shown by the X-rays, and though mathematics are not avoided, they are rather subordinate to the results of observation. Thus anyone who is sufficiently at home in the anatomy of the hand can follow the author provided only he take pains enough. Fischer's paper is the fourth part of his 'Gang des Menschen' in which the share of the foot in the walk is scientifically and mathematically studied. This puts it beyond the reach of most readers. Without pretending to be able to appreciate it, we think we run little risk, from the reputation of the author, in recommending it to students of this field.

The paper on the wrist is one that, while very valuable, is not of very general interest to readers other than anatomists. Since the introduction of the X-ray, hands, as convenient objects, have been photographed everywhere, and several anatomists have given attention to the movements of the bones. So far as the results obtained from the dead body go, we are not inclined to modify the opinion which we have expressed, namely, that the X-rays have done little more than confirm what was already known of the movements of the wrist. (This must however be understood with the proviso that more was known than was found in most anatomical. text-books.) But in these studies the living hand has been used, and although our contention still in the main holds good, it is to be admitted that *à priori* we really did not know how closely the movements made on a dead body reproduced the conditions which were the result of motions from within. The work has been very thorough, much attention being given to individual bones. Some of the views strike us as quite original. Thus we do not remember to have seen, in any of the monographs on this subject the position of the carpal bones in palmar and dorsal flexion shown directly from either the front or the back as in the usual view of the wrist. The objection which naturally presents itself, when such a course is proposed, is that the foreshortening of the flexed bones and the hiding of more or less of one row under the other would make the figure worthless, but this objection has by skill in technique been well met. The illustrations are admirable, and are made still more practical by being almost always accompanied by an outline drawing.

The results in the main are these: In lateral motions of the hand we may accept the theory of two oblique axes crossing each other at about the middle of the wrist with the proximal and distal angles larger than the lateral ones; but in flexion and extension we must assume a single transverse axis. A point emphasized is that the mid-carpal joint is a very important one. This is not new to anatomists, but we doubt if it is very familiar to the average student of anatomy. The work in short is both an interesting and a valuable one.

THOMAS DWIGHT.

The Teaching of Mathematics in the Higher Schools of Prussia. By J. W. A. YOUNG, Ph.D., Assistant Professor in the University of Chicago. New York, Longmans, Green & Co. 1900. Pp. xiv + 141.

The feeling that German schools have something well worth the American teacher's attention is not at all new. It has been said and written for a century, and within a few years it has given rise to the publication of several works of genuine merit, not to speak of numerous books and articles of no merit whatever. Of the former class this one by Professor Young is unique in that it is the first to devote itself entirely to the mathematical phase of education. Furthermore, it is somewhat unique in being a well-balanced, practical book for practical and well-balanced teachers. It tells one what one wishes to know. Not many Americans have been able critically to examine the subject of mathematics in Prussia. Here is a book that answers just the questions the intelligent teacher would ask if he were there, that gives him courage to face the issues of the present, and that should make him confident of the future. And it does all this, not by preaching American or German supremacy, but by intelligently pointing out the superior features of German education and by showing us our lines for improvement.

The real interest in the book is not so much in the carefully selected general information, for this it is not difficult to find in standard works like those of Baumeister and Russell, but in the consideration of the two questions: Are the Prussian schools doing better work in mathematics than the American? If so, how is this accomplished?

When we consider that we give about ten per cent. more time to mathematics than they do, that they recognize less home study than we, and that their children leave even the classical gymnasium knowing more of mathematics than do our high-school graduates in scientific courses, there can be only one answer to the first question.

The reasons for this state of facts are, briefly, the following: (1) The teachers in the gymnasia are men, and they enter the profession as a life work. (2) These men are university graduates, with at least two additional years of professional training. They have been rigidly examined, not by school teachers whose political pulls have given them place, but by university professors, specialists in their various subjects, appointed by the state. And in addition to all this, they have had at least one year of probationary teaching. Their examinations for the elementary classes include the calculus, and those for the high school grades require independence of thought in the higher geometry, in analysis, and in analytic mechanics, with a good knowledge of the literature of these subjects. (3) The teacher's position is one of honor, recognized in cases of superior excellence by the title of 'Professor,' bestowed by the government, a title with us 'defamed by every charlatan and soiled by much ignoble use.' (4) The teacher has fewer classes per week than the American teacher, and when out of class instead of being set to watch a 'study hall' he has time for recreation and study. (5) Considering the purchasing power of the money, the teacher comes, after a reasonable time, to receive a somewhat better salary than is offered in America, and hence a relatively stronger set of men enter the profession. (6) His countrymen appreciate that the teacher "can do his best only in an atmosphere of financial and mental tranquility. He must himself be continually growing, and if he is embarrassed by financial cares and harrassed by struggles to improve his material position, his growth is retarded and the quality of his work inevitably deteriorates." He is, therefore, accountable to no local authorities; political 'pulls' have no meaning to him; his superiors in law are his educational superiors as well. He works with the assurance that a pension awaits him when the 'rainy day' comes, and yet he is urged to progress by such manifold inducements that he does not stagnate. (7) The school year is longer than in America, the twenty-minute class periods of our lower grades are unknown, and hence the instruction means more when it is being given and is more consecutive than with us. (8) The teacher teaches; he does not merely hear a recitation. Text-books mean little; home study is not a serious matter; but the class period is a time for serious study, rapid work, heuristic teaching and general inspiration. Space does not permit of speaking of other reasons, or of the results of the system as shown by examination tests.

Professor Young does not, however, claim that Germany is all good and America all bad. Neither does he claim that we can adopt their system. He is eminently judicial in his conclusions, pointing out what we can safely use, and where we can unquestionably improve. On the whole, the book is one of the best balanced works on German education that have appeared, and as such is recommended to every American teacher of mathematics.

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SCIENTIFIC JOURNALS AND ARTICLES.

The *Botanical Gazette* for November contains the following leading articles: G. T. Moore has published with three plates his second paper entitled 'New or Little-Known Unicellular Algæ,' giving a detailed account of the life history of *Eremosphæra viridis,* and coming to the conclusion that for the present, at least, the genus should be classed with the Protococcoideæ; and also describing as a new genus a form which has been confused heretofore with *Eremosphæra,* and naming it *Excentrosphæra.* T. C. Frye has published with one plate an account of the development of the pollen in certain Asclepiadaceæ, his investigation having been suggested by the record that in certain members of this family there is no tetrad division. The development of the sporangium was found to be of the general type, the primary sporogenous cells passing over directly into pollen mother cells; these latter divide in the usual tetrad manner, but subsequently through mutual adjustment the four spores are arranged in a linear series. Miss F. Grace Smith has published the results of a large number of observations upon the distribution of red color in vegetative parts in the New England flora. A general conclusion is reached that the statistical observations obtained fit no one theory of color in all particulars. Mr. George A. Shull has published with illustrations the results of observations upon 'Some Plant Abnormalities.' He records instances of fasciation in *Erigeron Canadense* and *Echium vulgare;* abnormal foliage leaves in *Pelargonium* and *Hicoria;* and abnormal floral organs in *Lathyrus odoratus,* as well as in certain species of *Clematis.* Under the head of 'Briefer Articles,' E. B. Copeland has discussed Meissner's paper on evergreen needles, answering certain criticisms of the author, and presenting new observations; M. L. Fernald publishes a final paper upon the instability of the Rochester nomenclature, being an answer to papers of Messrs. C. L. Polard, L. M. Underwood and N. L. Britton; and Charles Robertson has published a third set of observations of flower visits of oligotropic bees.

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES. SECTION OF GEOLOGY AND MINERALOGY.

THE regular meeting of the Geological Section of the New York Academy of Sciences was held on Monday evening, November 18, with the chairman, Dr. A. A. Julien, presiding. The program of the evening was begun with the reading of a memorial of Dr. Theodore G. White by Professor James F. Kemp, who said in part:

Theodore Greely White was born in New York, August 6, 1872, and was the only child of his parents, both of whom he lost but a short time before his own death. He was graduated from the School of Mines of Columbia University in the course in geology and paleontology as Ph.B. in 1894, as M.A. in 1895 and as Ph.D. in 1898. He was appointed assistant in the department of physics in 1896 and held the position until 1900, being especially in charge of the experimental work in optics. From early boyhood Dr. White was interested in natural science, and while yet an undergraduate he began investigations both geological and botanical. His bachelor's thesis was a description of the geology of Essex and Willsboro towns on Lake Champlain, and he took up the study of the faunas of the Trenton group in the Champlain valley for his doctorate. In the end he extended these faunal studies all around the Adirondack crystalline area. He also carried on work for the New York State Museum under the direction of Dr. F. J. H. Merrill; and, in association with Professor W. O. Crosby, he described the petrographical characters of the Quincy granite. During an excursion to the seashore last summer he became exhausted while bathing in the salt water, and took a cold which developed into pneumonia and caused his death on the 7th of August, after a brief illness. Dr. White was a man of indefatigable industry and of great perseverance. He has left a large circle of sincere and devoted friends who can with difficulty reconcile themselves to his loss.

The second paper was a memorial of Professor Joseph Le Conte by Professor John J. Stevenson. A memorial of Professor Le Conte having appeared in the columns of SCIENCE, an abstract of this paper will not be given here.

The next paper was by Dr. Edmund O. Hovey and was entitled 'Notes on the Triassic and Jurassic beds of the Black Hills of South Dakota and Wyoming.' In this paper the author described, with the aid of a map and a number of lantern slides, the geological characteristics, the stratigraphic relations and the topographic features of the famous Red Valley of the Hills and its inclosing rim of Jurassic shales and sandstones; the observations being, for the most part, a result of a collecting trip made for the American Museum of Natural History during the past summer.

The closing paper was by Dr. Alexis A. Julien and was a discussion of 'Erosion by Flying Sand on the Beaches of Cape Cod.' The author said in part: The physical characters of the beach sand of Cape Cod show, in general, its recent derivation from the adjacent beds of the later Tertiary and especially from sands and gravels of Glacial age. In form the sand grains are mostly angular to subangular with but small admixture of those nearly spherical grains (for which I have proposed the term 'palæospheres') the form of which would indicate long erosion and high antiquity. In constitution the sands differ somewhat from those of the Atlantic coast to the southward, *e. g.*, of Long Island and New Jersey, particularly in a smaller content of iron-oxides and garnet. Through the continual movement of the winds over the peninsula, the sand upon the beaches and dunes is in a state of constant motion. During the frequent winter storms it is even borne along in vast quantities by aërial transport, and commonly with a violence sufficient to produce sharp attrition upon fixed solid objects.

The distribution of the sand is carried on from two directions: from the west along the south shore and from the north along the east and west sides of the 'forearm' of the Cape. The result is that the elbow tends to extend farther into the ocean, and Massachusetts Bay is a pocket steadily filling up with sand from the north. With the great fall of the tide on that coast, however, broad shoals are daily offered to sun and wind and the dried sands are constantly blown up on the highest dunes of the Cape, viz., those near Barnstable. There are ancient dunes along the coast, sometimes farther inland and even covered by forests, whose aggregation may be attributed to special violence of wind action at a remote period.

The most prominent results of the erosive action of the wind-driven sand are those pertaining to the general sculpture of headlands and summits of dunes, and the eating away of the softer layers of gravel and sand of which the bluffs along the east coast consist. The fine example of such erosion at Truro was described in detail and illustrated by means of a photograph. The recession of the face of the bluff here and everywhere from a vertical plane clearly indicates that its principal erosion is being constantly carried on by aërial rather than by marine attack. On the Cape, as elsewhere along our Atlantic coast, it is a common error to attribute the ravages on bluffs and dunes, noticed after a severe storm, too much to the incursions of the sea. A very large part of the damage has been done by the violence of the wind, reinforced by vast quantities of sand and spray lifted up and hurled continuously for hours against all opposing objects.

Other effects of the natural sand blast are shown in the pitted surfaces of small bodies strewn upon the beach, in the projecting hard minerals of the beach pebbles and in the depolishing of exposed portions of bits of glass and pottery. 'Faceted pebbles' are lacking from the beaches, because there is too much motion to permit of grinding anything to a flat surface. The rapidity of the eroding action under favorable circumstances is surprising. During the great gale of November 25, 1899, one night sufficed to convert into ground-glass the window panes in the exposed sides of the life-saving station at Truro. No scratches or grooves appear in these surfaces, such as have been observed in the sand-fretted pebbles of a desert, the conditions of sand erosion on a beach tending to pit the surface rather than to produce striæ.

The least obvious, but perhaps the most important, effect of this form of erosion is upon the flying sand grains themselves by mutual attrition, minute particles not being protected from wear as they are when suspended in water. By the splitting of particles from the grains and their own final reduction to the most minute size, the production of silt is constantly in progress upon these windy beaches, and it is regularly carried away in suspension by every tide.

The papers of the evening were discussed by Professors J. J. Stevenson and R. E. Dodge and Dr. A. W. Grabau.

In response to an invitation from the chair Dr. W. S. Yeates, State geologist of Georgia, gave some account of the history of the geological survey of that State and a brief statement about the work being carried on by the present organization. Appreciative comments were made by Professors J. F. Kemp and J. J. Stevenson and Mr. G. F. Kunz.

Edmund O. Hovey,
Secretary.

RESEARCH CLUB OF THE UNIVERSITY OF MICHIGAN.

At a meeting of the Research Club of the University of Michigan, held November 7, 1901, the evening was taken up with the presentation of papers by Professors Rolfe and Novy.

Professor Rolfe spoke on 'The Use of Ellipsis in the Explanation of Grammatical Phenomena.'

Dr. Novy gave an account of the investigations which Dr. Freer and he had carried on during the past year. After reviewing the work hitherto done concerning the action of metals, such as gold and copper, upon bacteria, it was pointed out that the explanation of this action as offered by Behring was insufficient, and that there was good reason for believing that such metals exerted a surface action resulting in the formation of peroxides which clearly possessed a greater germicidal action than hydrogen peroxide. The action of light upon bacteria, especially of sunlight, was discussed, and although the studies of Richardson, Dieudonné and others rendered it certain that hydrogen peroxide was formed under these conditions, nevertheless it was by no means demonstrated that this substance was the active germicidal agent. These considerations led the authors to the belief that the germicidal effect of metals and of sunlight was due to higher and more active peroxides. Accordingly a number of organic peroxides were prepared and their action on bacteria was studied. Several of these were found to be wholly inert. This was the case with aceton peroxide and dibenzoyl peroxide. On the other hand, the diacetyl and the benzoyl acetyl peroxides were found to be extremely germicidal. It was pointed out, however, that these bodies were not germicidal as such, but that in aqueous solution hydrolysis took place, resulting in the formation of acetyl hydrogen peroxide and benzoyl hydrogen peroxide respectively. The intense germicidal as well as oxidizing power of such solutions was therefore due to the products of hydrolysis.

It was pointed out that these last mentioned peroxides were capable of destroying the most resistant spores usually inside of a minute. A comparison with hydrogen peroxide showed that this substance was much more feeble in its action. In order to obtain approximately the same germicidal effects it was necessary to prepare solutions of hydrogen peroxide which contained eighty times as much active oxygen as that contained in a solution of benzoyl hydrogen peroxide. This fact was interpreted as showing that the organic peroxides exerted their germicidal action not through nascent oxygen, as is commonly held in the case of ozone and hydrogen peroxide, but rather through other means, possibly through ions. In the subsequent discussion it was pointed out that other interpretations were possible; that the oxygen liberated might possess a higher potential energy than that from hydrogen peroxide; or that the organic peroxides might be dissociated, as in the case of alcohol, not so much into ions as into one or more active parts.

Dr. Novy also detailed at some length the investigation bearing upon the relation of the surface action of metals to the formation of benzoyl acetyl peroxide. Metals, paper and fabrics, as well as sand, originally employed by Erlenmeyer and by Nef, exert a marked favoring action which may be interpreted as due to occlusion and partial dissociation of oxygen.

FREDERICK C. NEWCOMBE,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

At the meeting of the Academy of Science of St. Louis on the evening of December 2, 1901, the following subjects were presented:

Mr. J. Arthur Harris presented in abstract a paper on 'Normal and Teratological Thorns of *Gleditschia triacanthos* L.'

Professor A. S. Chessin, of Washington University, delivered an address on 'The harmony of Tone and Color.' The speaker said that although the idea is not new that colors, like tones, are subject to laws of harmony, he did not know that any systematic theory concerning this had thus far been presented, and the object of the paper was to establish such a theory. A color-scale was constructed and the properties of the intervals corresponding to those appearing in the musical scale were discussed, and the conclusion was reached that within the limit of an octave the laws of harmony in tone and color are identical.

A paper by Professor A. S. Chessin, on 'The true Potential of the Force of Gravity,' was presented and read by title, the author remarking that this was the first of a series of detailed papers bearing upon the general subject, the broad conclusions concerning which he had presented in synopsis at a recent meeting of the Academy.

A committee was elected to nominate officers for the year 1902.

WILLIAM TRELEASE,
Recording Secretary.

SHORTER ARTICLES.

THE SMALLEST KNOWN VERTEBRATE.

THE United States has borne the distinction of having, in certain cyprinodont fishes of the Southern States, the smallest known fishes and at the same time the smallest known vertebrates. Thus, *Heterandria formosa* Agassiz, found from South Carolina to Florida, has an average length of 25 mm. for females and 18 to 19 mm. for males. *Lucania ommata* (Jordan), recorded only from Florida, probably never exceeds an inch in length; two males, the only ones thus far found,* measured 19.5 and 20 mm., and two females from the same locality were 20 and 22 mm. long, exclusive of caudal fin. Of this species Dr. O. P. Hay† remarked that 'it may contend with *Heterandria formosa* for the honor of being the smallest known vertebrate.' Another diminutive member of the cyprinodontids is the well-known viviparous *Gambusia affinis,* the adult males of which sometimes barely exceed 12.5 mm. in length, although the females reach a length of 50 mm. In this family are several other species that are scarcely larger than those before mentioned. The pigmy percoidean, *Elassoma evergladei* Jordan, of the swamps of Georgia and Florida, ranges from less than 20 mm. to a maximum of about 33 mm. in standard length, and several of the darters are no longer. Among the marine fishes, there are a number of gobies whose length is barely 25 mm. The smallest of the known marine vertebrates, however, is probably the lancelet, *Acymmetron lucayanum* Andrews, from the Bahamas; examples taken by the *Fish Hawk* in Porto Rico are about 19 mm. long, although Dr. Andrews' types in the National Museum are nearly a third smaller.

The United States Fish Commission has recently received from the Philippine Islands numerous specimens of a species of fish now to be described which has a maximum size less than the minimum adult size of most of the foregoing species, while the minimum and average sizes for mature individuals are thought to be less than those of any other known fish or other vertebrate. The specimens were obtained, through the courtesy of the Surgeon-General of the army, by medical officers connected with the military hospital at Buhi, southern Luzon, in the department of Camarines Sur; and were collected in Lake Buhi, to which the species is said to be peculiar.

The fish is a member of the great cosmopolitan goby family, of which upwards of 600 species are known; and exhibits peculiar characters which necessitate the creation of a new genus for its reception. The diagnostic features of this genus, for which the name *Mistichthys* (μεῖστος, the smallest) is proposed, are coalescent ventral fins not adnate to the abdomen, two well-separated dorsal fins of which the anterior contains three weak spines, a single series of conical teeth in each jaw, body covered with large ctenoid scales, and an elongated genital papilla by the shape of which the sexes may readily be distinguished.

This species, to which the name *Mistichthys luzonensis* is given, and which will be more fully described in a forthcoming paper in the Fish Commission Bulletin, is apparently nearly transparent in life, with a black chin, a black median line behind the anal fin, and a few black spots on the back. It is probably viviparous or ovo-viviparous; but while many of the specimens contain ripe ovarian eggs (some of which have been discharged in the preserving medium), no eggs exhibiting evidences of development have been found. The females are slightly larger than the males and average 13.5 mm. in length; the maximum for egg-bearing fish is 15 mm. and the minimum less than 12 mm. The average length of males is about 12.5 mm., the maximum is 13.5 mm., and the minimum is under 10 mm. The average length of 50 specimens taken at random, both sexes about equally represented, was 12.9 mm.

A fact of more than ordinary interest in connection with this diminutive species is that it is a food-fish of considerable importance. Dr. George A. Zeller, acting assistant surgeon U. S. A., writing from the military hospital at Buhi, says:

"I enclose herewith samples of a strange

* Woolman, *Bulletin U. S. Fish Comm.*, 1890.

† *Proc. U. S. Nat. Mus.*, 1885.

article of diet greatly relished by the Bicols, among whom I have been stationed for the past eighteen months. Rice and fish are the staple articles of diet for most Filipinos and in the provinces of the Camarines there is little variation from these two. Fishes of every size and many varieties are prepared in every conceivable form, but the samples enclosed are unique in that they are found here and nowhere else. * * * Many varieties of fish abound in the lake, but by far the most numerous are these minute specimens. They are called in the native Bicol tongue *sinarapan,* and when dried in the sun on a leaf are called *badi.* They are caught by a large sheet of close web, which is dipped under wherever a school congregates. They are put into tightly woven baskets from which the water soon drains, leaving a compact mass of fish. They are not minnows or immature fish. They are adults and attain no greater size. The natives buy them eagerly; and when the little fleet of fishermen return from their morning's quest and place their baskets upon the ground on the market place, they are instantly surrounded by a crowd of waiting children who, armed with every sort of dish, are anxious to take home the family meal. They bring three or four potato tubers, a handful or two of rice, or a few copper pennies, and in exchange receive about a pint of fish. In the kitchen the fish are made up with peppers or other spiced herbs, and they do not taste bad. The soldiers have become quite fond of this food, and liberally patronize the little native restaurants where it is served."

H. M. SMITH.

WASHINGTON, D. C.

DINOSAURS IN THE FT. PIERRE SHALES AND UNDERLYING BEDS IN MONTANA.

IN the summer of 1900 I made a collection of Dinosaur and Mosasaur remains from the Ft. Pierre beds, near Fish Creek, in Sweetgrass County, in Montana. I have not noticed any account of the collecting of Dinosaurs from this horizon.

The beds are composed of dark-colored shales, with occasional very thin lenses or layers of sand. Sometimes the shales have no grit, sometimes they contain much fine sand. There are many brown or grayish, rounded concretions or concretionary layers. These concretions are often very hard. In these are many of the fossils, both vertebrate and invertebrate. The mollusca are principally the well-known, characteristic Ft. Pierre forms such as Ammonites, Baculites, Scaphites, Nautali and many smaller forms.

In this locality the weathered surface of the beds forms a rolling, grass-clad prairie with occasional ravines cutting into the soft shales. The bones are sometimes found in these ravines and 'cut banks' and sometimes among the grass roots, some of the bones projecting above the short grass.

The harder sandstones in the formation above form a line of bluffs or 'rim-rock' which for many miles marks the southern boundary of the Ft. Pierre shales. There are also dark shales interbedded with these sandstones. This formation contains leaf impressions and many fragments of Dinosaur bones, but the fossils have not been studied and no characteristic ones were recognized.

Below the Ft. Pierre shales are hard, rather thin-bedded sandstones with interbedded shales. Still lower are hard and soft sandstones, the latter predominating. These contain plant impressions, fossil wood, a few apparently fresh-water or brackish-water shells and Turtle and Dinosaur bones. The latter, many of them, were in a beautiful state of preservation, but no nearly complete skeletons were found. In these beds are bands of peculiar black or very dark, hard nodules, that look something like basalt. These sometimes contain bones. The Dinosaur remains are of the *Claosaurus* type.

From the Ft. Pierre beds the greater part of the skeleton of one Dinosaur and a good number of bones of another were obtained, besides he skull and other parts of Mosasaurs. The more complete Dinosaur skeleton is in the museum of the University of Montana. It undoubtedly is a *Claosaurus.* The other portion of a skeleton is in my collection. It is much smaller and was undoubtedly quadrupedal in gait. The sacrum is nearly complete and is different from anything else that I have seen.

It is composed of three ankylosed vertebræ.

It is interesting to find Dinosaurs in these marine beds. The marine fossils are found mixed with the bones. While digging out the skeleton of *Claosaurus* nearly a dozen *Nautali* were found among the bones. As a rule, when bones are found a good part of the skeleton is there or there is evidence that it has been. Several skeletons had been found and the bones removed for curiosities before I had visited this region. The first skeleton I saw was shown to me by a young man, Mr. Albert Silberling, who lived on the ranch from which the others were dug. I think that very few fossil-hunters would have looked for Dinosaur bones here.

It seems that these deposits were made in a shallow inland sea or an estuary which, at least during a part of the time, was cut off from the ocean, for in places there is considerable gypsum. Perhaps we should hardly expect to find such large marine mollusca in such a place, but they evidently are not far from where they died. There is no evidence of strong tides, and if the shells had been washed up by these or the winds they would be broken, not complete as we find them.

As a rule land animals are not very perfectly preserved in marine deposits. In unearthing these animals, therefore, the question is always arising: "How did these bones get here?" Did these Dinosaurs that have been so modified, evidently fitting them for life on land, still retain their swimming habits, but occasionally suffer shipwreck and their carcasses sink to the bottom of the sea? By some invasion of the sea were they forced to stay and starve or 'swim for life' which proved in some cases to be for death? I have seen no indications that they were killed by violence or their carcasses destroyed by large carnivorous animals, though there has been a little disturbance of the bones. Did they die on some mud flat or did their carcasses float down some sluggish stream and get stranded in shallow water or get 'water-logged' and sink in deeper water? These are interesting questions, but more thorough and careful investigation is needed to decide the matter with any degree of certainty.

The University of Montana hopes before very long to publish a bulletin describing these beds and whatever is of interest in the collections obtained from them.

Earl Douglass.

Princeton, N. J.

MAGMATIC DIFFERENTIATION OF ROCKS.

Since the time when the celebrated chemist Bunsen first elaborated his theory on the nature of rock magmas, the subject has been of great importance to the geologist. If one were asked to name three of the grander ideas which mark the progress of geology during the century just closed, this conception of magmatic differentiation of rocks would certainly be one of them. Of late years contributions to the subject have been numerous and important. Several of the most recent are especially noteworthy.

In the reconsideration, by H. S. Washington (*Bulletin Geological Society of America*, Volume XI.), of the 'Igneous Complex of Magnet Cove, Arkansas,' made exceptionally interesting through the elaborate efforts of J. Francis Williams, are recorded some observations on magmatic differentiation that are of unusual significance at this time. Contrary to previously expressed opinion, the several types of deep-seated rocks represented in the complex are regarded as integral parts of one great mass and as contemporaneous in origin, and therefore not due to successive intrusions. Furthermore, the structure of the whole mass is probably laccolithic in character.

A remarkable feature connected with the zonal distribution of the various rock-types is the complete reversal of the order almost invariably found among large masses of cooled magmas. Ordinarily the borders are basic and the central parts more acidic. But in the Magnet Cove mass the heavy constituents are in the center and the lighter silica, alumina and alkali components are on the edges. Notable instances of similar character are reported from Norway, Finland and Montana.

The exceptional character of the Magnet Cove mass appears to suggest unusual conditions. While the general subject of the causes of differentiation is not discussed at length, a possible explanation for the Arkansas complex is offered. Briefly stated, the essential idea is that, just as in a highly cooled vessel of salt water the ice crystallizes at the sides, bottom and top, leaving a core of more concentrated liquid at the center, so here the solvent may have frozen out, collecting at the borders of the cavity in a more or less pure condition, as foyaite, and gradually becoming more basic (richer in the solute) as the freezing process crept towards the center.

Although the great work of the Russian petrographer, F. Loewinson-Lessing, on the Eruptive Rocks of the Central Caucausus, was issued more than two years ago, the views advanced are only beginning to get into form accessible to the majority of English students. The general interest lies in the discussions of the subjects of rock-classification and the differentiation of rock magmas.

The classification proposed for the igneous rocks is chemical. It is based primarily upon the degree of acidity of the silicate minerals. Four great groups are thus established: (1) The ultra-basic rocks, derived from a monosilicate magma, (2) basic rocks, which had a bisilicate magma, (3) neutral rocks, with a magma which was bisilicate or normal, and (4) acid rocks, in which the magma was polysilicate. These groups are subdivided in 14 sub-groups and 34 families.

In order to find the proper systematic position of an eruptive rock from the fundamental viewpoint of the proposed classification four factors are considered: (1) The relation of the oxygen in the silica and that in all the other oxides taken together, giving what is termed the coefficient of acidity; (2) the chemical composition, which gives for each type a distinctive formula; (3) the relations between the two groups of oxides according to their molecular proportions; and (4) the relations of the soda and potash in the alkaline rocks. This consideration of the principles of classification leads to the proof of the distinct phases of fundamental magmas.

Discussion of the differentiation of rock magmas has an unusual interest. The Russian author calls special attention to the principle of Soret, the action of super-saturated solutions, the effect of gravity, the principles of maximum work as proposed by Berthelot, and the reaction of mixed liquids, as operating in the separation of magmas.

Three distinct kinds of magmatic differentiation are recognized. They are: Static differentiation, taking place in the depths of the earth; differentiation by cooling during ascent to the surface; and crystalline differentiation. Specific gravity, pressure and temperature are the chief factors governing the course of the static kind; while chemical affinities come into play in large measure only in crystalline separation.

The rôle of inclusions of foreign rocks, which has so long been such an unsatisfactory subject to petrographers, is explained on the idea that it is only that portion of the magma yet undifferentiated which affects the introduced rocks. After thorough assimilation of limestone, for example, a separation of the modified magma takes place. One part contains very little lime and the other nearly all of it. Rock formed from the first mentioned might be a granite, while from the second would come perhaps a gabbro.

CHARLES R. KEYES.

ON THE REASON FOR THE RETENTION OF SALTS NEAR THE SURFACE OF SOILS.

VERY recently a light-colored saline incrustation was noticed by Professor Milton Whitney upon the surface of the soil in the grounds of the Department of Agriculture in Washington. This crust was collected and examined in the laboratory of the Bureau of the Soils under the direction of Dr. Frank K. Cameron. The crust contained about 1 per cent. of soluble matter, principally sulphates and nitrates of sodium and calcium. Samples were then collected at different depths and examined to determine the vertical distribution of the soluble salts. The results showed that although the soil was examined to a depth of three feet, practically all of the salt was in the surface inch, the larger part of it being in the top eighth-inch.

The crust was found at the end of a short, dry season, such as is common in the autumn months along the Atlantic coast region.

A number of similar occurrences of abnormal amounts of soluble matter on the surface of the soils of humid regions have been reported, but very little has been written about them. Cameron has, in Bulletin No. 17, Division of Soils, described a number of occurrences of crusts in humid regions, and has called my attention to several others which were not known to him at the time his paper was published. All of these cases were after a short season of dry weather, but it must be admitted that their occurrence seems rather an anomaly when the heavy rainfall is considered. For what is the reason that this salt remains near the surface of the ground when the water from the rains passes down through the soil? If the salt which is soluble in water is dissolved by the downward percolating rains, why is it not continually washed deeper into the subsoil? Why is it that, in spite of the fact that more water passes downward than returns to the surface by evaporation and capillary movements upward, analyses of soils in the humid regions invariably show more soluble matter in the surface soil than in the subsoil?

There are several reasons which may account for this seemingly anomalous condition of affairs. First, in the soils of the humid region the great bulk of the decomposition of the soil minerals and the consequent liberation of soluble matter takes place within the soil proper in which the greatest aeration takes place, where the bacteria are most numerous and where tillage and sunlight and changes of temperature have a maximum influence.

A second reason which might be given is that of absorption. Very little definitely is known about the phenomenon called absorption, beyond the fact that it is a property of soil grains or of any surface by virtue of which matters in solution are held so that is difficult to wash them off, so that salts which are liberated during the processes of weathering are held near the surface by the absorption.

There is a third factor which seems to assist in accounting for the salts at the surface, and that is that there is a difference between the rates of downward and upward movements of salts within the soil.

When water falls on the soil both gravity and capillary attraction act in the downward movement. Capillary attraction is more effective in the smaller spaces between the soil grains, while gravity is more effective in the larger openings. When water leaches through a soil in a field, by far the larger part of it passes through the larger openings—those produced by insects, worm burrows, root holes, cracks, large interstitial spaces formed by coarse grains, etc. That such is the case is very easily proven if the rate of percolation is measured through a block of soil in field condition, and the same block is broken up dry, so as to prevent puddling and the rate of percolation is measured again. A simple examination of any soil in the field will reveal the presence of these larger openings, and as the resistance to flow varies as the fourth power of the diameter of the tube, a much larger amount of water passes downward through the large openings, than passes through the smaller true capillary spaces. These larger openings might well be called the gravitational spaces, and the smaller spaces in the soil grains the capillary spaces.

When water moves upward through a soil to replace that lost by evaporation or removed by plants, the movement is entirely capillary and the entire film around the soil grains moves.

Now let us consider the action which takes place when rain falls upon a soil covered with a thin soluble crust. First of all the soluble matter is dissolved and carried down into the soil. The downward-moving wave penetrates most rapidly along the gravitational spaces, since here the resistance is least and the front of the wave is drawn laterally into the true capillary spaces by surface tension. These capillary spaces, therefore, largely fill with water from the front of the wave, and since the front of the wave contains the greater part of the salt dissolved, this salt is thus retained in the capillary spaces. As soon as the capillary spaces are filled, practically all movement in them ceases, except the slow downward percolation caused by gravity, and in a soil of average texture this movement is practically nothing. The movement in the gravitational spaces continues. The salt in the water which was drawn back from the front of the penetrating wave remains stationary or only escapes out into the gravitational spaces by diffusion.

When the rain ceases the gravitational spaces drain of water, carrying off relatively a small part of the soluble matter, and the evaporation from the surface causes the upward movement to commence, but this movement is entirely capillary and the whole film around the soil grains moves, and as it moves so does all of the salt except possibly that portion absorbed, and there is evidence which leads one to believe that the absorbed salt moves also, but rather more slowly than the film; that is, the absorbed salt shows a tendency to lag behind.

Therefore, it will be seen that the rains do not move the salt as far down as they penetrate but leave the most of it near the surface of the soil or at least so close to the surface that capillary movements will again accumulate at the surface as soon as the dry season occurs.

This explanation of the movement of soluble salts within a soil finds application in a number of ways. In the arid regions, where the soluble salts are more abundant than in the humid climate, and where the movements of these salts, if not understood and controlled, ofttimes result in the accumulation of soluble matter this explanation of the difference in the rate of downward movement, compared with the upward movement, goes far to explain some points which were heretofore but imperfectly understood. For example, it has always been difficult for the writer to understand why alkali salts should continue to accumulate at the surface of the ground in spite of the repeated irrigations, and the maxim laid down by agriculturists in that region that 'alkali goes with the water.' In one district of especial notoriety in California the water table was thirty years ago about sixty feet below the surface of the ground and there were no indications of alkali. Irrigation was commenced and continued large and excessive quantities were used. All of the time the water table was steadily rising, showing unquestionably that more water went downward through the soil than came up for evaporation, and yet in spite of this accumulative downward movement of the water the alkali salts, which, so far as can be gathered from adjacent unirrigated areas, was within the surface twenty feet of the soil, have been steadily creeping upward and at the present time fully ten per cent. of the area is suffering from an excess of alkali salts.

It is plain that if we desire to send the salts downward the easiest way to do it is to make the downward movement, as far as possible, capillary instead of gravitational. One way of doing this is to break up the soil gravitational spaces by deep cultivation and subsequent firming by flooding. Such has been found very effective in certain areas of Arizona. Another way is to flood the soil with frequent shallow irrigations. In this way a slow downward capillary current is kept up. Half a dozen floodings with one inch of water each will be found to carry downward much more salt than one flooding of six inches.

Another lesson taught, one well known for many years, is that if the subsurface water is alkaline it must not be allowed to rise so close to the surface that continuous upward capillary movement is possible; else the alkali will accumulate in the soil, to its detriment.

THOS. H. MEANS.
BUREAU OF SOILS,
WASHINGTON, D. C.

CHEMISTRY IN THE CALIFORNIA SCHOOLS.

THE chemistry teachers of the Pacific coast have organized an association to encourage the teaching of chemistry, to harmonize methods, to become acquainted with each other and with the needs of the country and the conditions affecting their profession; and, generally, for all those purposes for which association is good. The organization was effected last August, during the Summer School session of the University of California, at which many teachers from California and from the neighboring States were present. The headquarters of the organization are at Berkeley, which, as it is the educational center of the western part of the country, is the natural location for such a purpose. Two members of the faculty of the University of California, one in the department of chemistry and one in the department of physics, were among the organizers.

The need for such an organization is shown by the number of schools in which chemistry is taught. A recently published list shows that there are 116 schools in California whose graduates are admitted by the University of California without entrance examination. Twenty-five of these are not accredited in chemistry, but the remaining ninety-one have chemistry courses sufficiently thorough to satisfy all University requirements. And in the twenty-five not accredited in chemistry the subject is taught in most cases, though not with the necessary thoroughness. Moreover, there are many other schools in the State whose graduates are not accorded free entrance to the University, and the names of which do not, in consequence, appear on the published list, in which chemistry is one of the subjects taught. It is probable that in the State of California alone there are at least one hundred and fifty chemistry teachers; and it would be making a very modest estimate and one undoubtedly far below the true numbers to estimate at two hundred the chemistry teachers who look toward Berkeley for their inspiration.

As yet the new organization is in a formative condition. It has been getting itself together, rather than attempting to accomplish anything. Its first circular of information, just published, contains, however, a number of interesting facts. On data, not as complete as desirable, it was shown that the high-schools of California give their students a year of chemistry, recitations being supplemented with laboratory practice. The majority of the schools report fairly good laboratory facilities, one small school in the southern part of the State claiming to have a better equipment for elementary work than does the University itself. Of books of reference there is an almost total lack. In many cases there are no reference-books whatever.

One of the interesting features of the first circular is a letter from President Ira Remsen of Johns Hopkins on the proper methods of chemistry-teaching. He writes:

I thank you for the opportunity you have given me to say a few words to the members of your association. The formation of such societies as yours will, I am sure, do much to further the study of chemistry and raise the standard of teaching. As I have watched the work of teachers of our science in schools, in colleges and in universities, it has seemed to me that the chief defect is what in plain English may be called slovenliness. The students get into bad habits of work and have no clear idea in regard to what they are doing. They are often left to themselves too much and work as they ought not to, without knowing that anything is wrong. Then, too, when the students attempt to give an account of what they have done, they use language that would hardly be permitted in a recitation room or in writing about a literary or historical subject. The language and the notebooks are apt to be slovenly, especially if the work has been slovenly. Now, we shall never get what we ought to get from laboratory courses in chemistry or any other subject until this slovenliness is eliminated. The ability to state the source of an element, its properties or the law of definite proportions or any other law—this ability is of little value. This kind of knowledge is meaningless unless based upon some actual experience in the laboratory.

Courses in scientific subjects are still on trial, and we teachers of chemistry are to determine by the way we do our work whether these courses are to be recognized as valuable from a purely educational point of view. Too much of the instruction now given seems to be shaped with the idea that the pupils are all to become chemists. As a matter of fact, this is true of very few of them. But I may as well stop here. I have opened up too broad a subject to be dealt with satisfactorily at this sitting.

EDWARD BOOTH,
Secretary.

SCIENTIFIC NOTES AND NEWS.

PROFESSOR YVES DELAGE has been elected a member of the Paris Academy of Sciences in the section of zoology, in the place of the late Lacaze-Duthiers.

MR. PHILIP WATTS, F.R.S., has been appointed director of naval construction by the British Board of Admiralty, succeeding Sir William H. White, F.R.S., who has resigned in consequence of ill health.

DR. CHARLES PORTER, M.D., of Shrewsbury, has been selected for the appointment of medical officer of health to the municipality of Johannesburg. The salary is £2,000 per annum.

WE learn from the *American Geologist* that Dr. H. M. Ami, of the Geological Survey of Canada, who sustained a rather severe injury to his left arm and shoulder last September, from a fall down a steep cliff at Cap à L'Aigle, below Quebec City, is sufficiently recovered to resume his official duties at Ottawa.

DR. J. W. SPENCER is at present engaged in geological explorations in Central America.

UNDER the auspices of the astronomical department of Columbia University Sir Robert S. Ball will lecture in Havemeyer Hall, on January 10, at 3:30 P. M. His subject will be 'The Cause of an Ice Age.'

DR. SVEN ANDERS HEDIN, the Swedish traveler, who recently reached Ladakh, Cashmere, from exploring the Gobi desert and Thibet, has informed King Oscar that his party was attacked by Thibetans during his journey and that all his collections and almost the whole of his caravan was lost, but that his notes were saved.

DR. ALES HRDLICKA will start about January first on his fourth expedition among the Indians of the southwestern United States and northern Mexico. These expeditions are a part of the system of anthropological exploration and investigation known as the Hyde Expedition and are carried on under the direction of Professor F. W. Putnam for the American Museum of Natural History. The expenses of the present undertaking are generously provided for by Mr. F. E. Hyde, Jr., of New York City. Dr. Hrdlicka is in charge of the somatological work of the Hyde Expedition and his plan, now more than half fulfilled, is, in the main, to ascertain the physical characteristics of the extinct as well as the living peoples in that area which has once been occupied by the Cliff-Dwellers and Pueblos, and by the Toltec, Aztec and Chechemec peoples. It is hoped that on the present journey the somatological part of the research in the field will be completed. The principal tribes that will be studied on the present trip are the Pimas, Papagos, Yaquis, Mayos, Tepehuanes, Coras, Aztecs and Tarascos. Dr. Hrdlicka will be accompanied and assisted by Mr. Gustavus Meyers, of New York City.

THE editors of the *Botanische Centralblatt* for Great Britain are: Algæ, Miss Barton, British Museum (Natural History); Fungi, Mr. Massee, Royal Gardens, Kew; Archegoniatæ, Mr. A. Gepp, British Museum (Natural History); Phanerogams, Mr. Daydon Jackson, 21 Cautley Avenue, Clapham Common, S.W.; Cytology, Professor Farmer, Royal College of Science, S. Kensington; Physiology, Professor Vines, Headington Hill, Oxford; Morphology, Dr. W. H. Lang, University, Glasgow; Paleontology, Professor Scott, Old Palace, Richmond, Surrey.

MR. CLARENCE KING, the eminent geologist, died at Phœnix, Arizona, on December 24. Born in Newport, R. I., he graduated from the Sheffield Scientific School of Yale University in 1852, and joined the California Geological Survey in 1853. He was instrumental in the organization of the U. S. Geological Survey, of which he was director from 1878 to 1881. We hope to give subsequently some account of Mr. King's geological work.

SIR JOSEPH HENRY GILBERT, the well-known agricultural chemist, died on December 23, aged 83 years. With Sir John Bennet-Lawes, he was over fifty years director of the Rothamsted Laboratory, and was for some years professor of rural economy at Oxford University He was a fellow of the Royal Society and a correspondent of the Paris Academy of Sciences.

MAJOR ROBERT TEMPLE, the well-known southern engineer, died at Richmond, Va., on December 22, at the age of seventy years.

Nature records the death of the Rev. Hugh Alexander Macpherson, of Glendale, at the early age of forty-three. Mr. Macpherson was an authority on the fauna of the lake country, and had published an elaborate work on the subject, 'A Vertebrate Fauna of Lakeland, including Cumberland and Westmoreland, with Lancashire North of the Sands.' He was also the author of a book entitled 'British Birds.'

MR. ANDREW CARNEGIE has offered the city of Akron $70,000 for a free public library, the city to guarantee $7,000 annually to maintain it.

The Misses Olivia and Caroline Phelps Stokes have presented to the Board of Managers of the New York Botanical Garden, $3,000, on condition that the interest of this fund should always be used for the investigation and preservation of native plants, or for bringing the need for such preservation before the public. The income this year is offered in three prizes for papers on the subject mentioned. The papers must be presented not later than February 1, 1902.

At a meeting of the trustees of the Connecticut Agricultural College, on December 27, a resolution was passed favoring a bill now before Congress providing for the study of forestry and mining in the agricultural colleges.

An Anthropological Club was recently organized at Yale University. Dr. Kellar presided and Professor Sumner outlined the subjects to be treated. The attendance was eighteen.

The Society of College Gymnasium Directors met at Columbia University on December 27 and 28. The following officers were elected: *President,* Professor Paul C. Phillips, Amherst College; *First Vice-President,* Edward Hitchcock, Jr., Cornell University; *Second Vice-President,* Dr. Frederick E. Parker, Brown University; *Secretary and Treasurer,* Dr. James A. Babbitt, Haverford College; *Executive Committee,* Dr. R. Tait McKenzie, McGill University, Montreal; Dr. Dudley A. Sargent, Harvard, and Dr. William G. Anderson, Yale; *Council and Committee on Admissions,* Dr. Casper W. Miller, University of Pennsylvania; Dr. Watson Lewis Savage, Columbia; Professor A. Alonzo Stagg, University of Chicago, and the officers of the Society, *ex-officio. Committee on Strength Tests and Inspection of Instruments,* Dr. Sargent, Harvard; Dr. Savage, Columbia, and Dr. Jay W. Seaver, Yale. *Committee on Nomenclature,* Dr. Anderson, Yale; Dr. Sargent, Harvard, and Professor George Goldie, Princeton.

The twelfth annual banquet provided for in the will of the late Henry Shaw, the founder of Shaw's Botanical Garden, was given on December 7, at the Mercantile Club, St. Louis.

The *Lancet* states that the fellows and associates of the Institute of Chemistry assembled under Professor J. Millar-Thomson, F.R.S., the president, for their annual dinner on December 4. The president was supported by a distinguished company. The minister of agriculture emphasized the importance of scientific chemistry to agriculture. The president gave a general report on the condition of the institute, pointing to the advance that that body was steadily making in the high standard of its examinations.

The Archeological Institute of America held its annual meeting at Columbia University, on December 27 and 28, under the presidency of Professor John W. White, of Harvard University.

At a meeting held in London on December 5, under the presidency of Dr. W. R. Smith, a medico-legal society was organized.

The *Lancet* states that at the meeting held on November 25, M. Gaule laid before the Paris Academy of Sciences the result of some researches which had been undertaken by himself with a view to ascertain whether the results of a balloon ascent were comparable with those obtained at a high altitude on land—*e. g.,* at the top of a mountain. The most notable of these is a marked augmentation in the number of red corpuscles. Viaux and sundry observers who followed him have ascertained that at a high altitude there is a great increase in the number of red corpuscles. Thus in the Cordilleras at a height of 4,000 meters, Viaux found 8,000,000 red corpuscles per cubic millimeter. M. Gaule wished to see whether in a balloon ascent, where ascension is very rapid and entails no muscular exertion, a similar phenomenon would occur. He made two investigations at heights of 4,200 and 4,700 meters and found in himself 8,000,000 red corpuscles per cubic millimeter. Further, M. Gaule at a height of over 4,000 meters made some blood-films stained after Ehrlich's method with eosin and hæmatoxylin. He found numerous red corpuscles which showed a nucleus colored blue by the hæmatoxylin. This nucleus was in many instances segmenting, and also groups of three or four corpuscles were seen as if they had undergone subdivisions. Similar preparations made before the ascent showed no such appearances. M. Gaule therefore considers that at high altitudes there is an actual formation of red corpuscles and that this takes place with great rapidity. At the following meeting M. Tissot and M. Haillon gave an account of researches on a somewhat analogous subject. On November 21 they undertook some researches at various altitudes into the physics and chemistry of the respiration. Experiments were made at the following heights: 1,350 meters, 2,600 meters, and 4,450 meters in the case of M. Tissot, and at 1,700 meters and 3,500 meters in the case of M. Haillon. The chemical phenomena of the respiration did not vary appreciably at these different altitudes. The respiratory rhythm, however, was greatly modified. Although the total quantity of air entering the lungs was less the number of respirations was not sensibly altered. It would thus appear that at high altitudes the air is purer and more completely used.

THE London *Times* states that Sir Colin Scott Moncrieff, has been appointed by the Secretary of State for India to preside over a commission to consider exhaustively the possibilities of further protection against famine by means of irrigation. His colleagues will be Mr. Ibbetson (recently appointed to fill a prospective vacancy in the Viceroy's council), Mr. Higham, of the Irrigation Department, and the Hon. Mr. Rajaratna Mudaliyar, of Madras. The Punjab, Sind and Rajputana are the parts of India to be first visited as being most susceptible to the advantages of irrigation. Other provinces will then be taken one after the other, Burma alone being left unvisited. In order that the commission may be assisted in its inquiries by local knowledge, each provincial administration has been asked to nominate an experienced revenue officer to be a member of the commission for the period that it remains in the province. The terms of reference to the commission show that the inquiry will be of a most exhaustive character. The Government resolution points out that the irrigation works hitherto constructed by the State have on the whole proved directly remunerative, but it is recognized that the program of works of this kind may be approaching completion. The great storage works required for any considerable extension of irrigation in tracts most exposed to famine must necessarily be more costly per acre protected, and therefore less remunerative than completed works, which draw unfailing and perennial supplies from the great rivers of Northern and Southern India. As regards new works, therefore, the Commission is directed to regard as the main question not whether they will be likely to prove directly remunerative, but whether the net financial burden which they may impose on the State in the form of charges for interest and maintenance will be too high a price to pay for the protection against famine which they may be relied on to afford. One of the most valuable results that may be anticipated from the labors of a Commission taking this as its guiding principle will be to authoritatively set at rest the assumption that in all cases areas liable to famine can be protected by irrigation with comparatively small cost annually to the State.

THE London *Times* states that the National Association of British and Irish Millers have decided to institute an inquiry into the whole question of the relative strengths of English and American wheats, and have secured the cooperation of the Southeastern Agricultural College at Wye, Kent, in the agricultural side of the work. The question has arisen in consequence of complaints by agriculturists that English millers will not purchase English-grown wheats as they did formerly, but give the preference to American wheat, though they have to pay a higher price for it. The millers reply that, however favorably they may be situated for obtaining home-grown corn, they cannot sell for bread-making purposes flour made from English wheats, because they lack the strength of the American kinds. It is hoped that the inquiry will result in an improvement in the quality and yield of English wheat. For this season the Southeastern Agricultural College is sowing the same wheats on different soils; different manures are being tried, and the wheats in each case will be tested by milling and baking. New varieties are being obtained from Canada and

America, and selection and cross-breeding will be tried to improve the yield of the old varieties, not by increasing the size, but by increasing the number of grains in the ear.

UNIVERSITY AND EDUCATIONAL NEWS.

By the will of Mrs. S. C. Warren, about $150,000 is given for educational and charitable purposes, including $5,000 to Harvard University for the Peabody Museum of Archeology and $5,000 to Williams College.

Palmer College, at Le Grand, Iowa, has received $30,000 from Mr. F. A. Palmer, of New York, making $50,000 given to the institution in the last six months.

A cable despatch to the New York *Sun* announces that the Chinese government has decided to present to Columbia University a compilation of Chinese literature, history, maps, illustrations and official papers in acknowledgment of the establishment of a chair of Chinese history, language, customs and manners in that institution. The recommendation that such action be taken was made by Liu Kun Yi, the Viceroy of Nankin.

The Philadelphia correspondent of the New York *Evening Post* records the buildings to be erected at the University of Pennsylvania, as follows: Engineering building and machinery, $500,000; gymnasium building and ground, $400,000; medical laboratories, $500,000; veterinary building, $150,000; and various sums for additions to the chemistry and physics laboratories. About one-half of this sum has been secured, and the plans for the new engineering building have already been completed. The equipment will cost over $200,000, and the building $300,000. The site for the new medical laboratories has been cleared and work begun on the foundations. The trustees plan to have the laboratories ready for use by the opening of the next college year.

Mrs. George Holt and Miss Holt have endowed a fellowship in physics in University College, Liverpool, to be associated with the name of Dr. Oliver Lodge, formerly professor of physics at the College, and now principal of Birmingham University. Its annual value will be £100 or more. A prize to be called the 'Oliver Lodge Prize' has also been established by Dr. Lodge's friends and late colleagues, to be awarded annually to the best student in physics in the third year of the honors course.

Cornell University will hereafter confer the degree of 'Forest Engineer,' in place of 'Bachelor of the Science of Forestry.' The arguments presented in favor of this change are as follows: (1) The degree 'Forest Engineer' expresses more adequately than the academic degree now conferred, and according to precedent in other technical arts, the fact that not a science, but an art of technical character has been studied to a certain degree, namely the degree of entering the student into the profession. (2) It expresses the kind of work—namely, the application of technical scientific knowledge to a business end in a productive industry—for which the student has been prepared as a professional man. (3) It does not, as does the academic degree B. S. F., place the scientific basis and the literary accomplishment before the professional result. (4) It is, in the eyes of the world, a prima facie title of practical attainments, fitting for employment in practical rather than literary or scientific work. (5) There is sufficient precedent, not only in other technical arts for the form of title, but in the art of forestry, wherever a title has been given outside of this country, it has assumed the form of Engineer.

At its next session the Legislature of Pennsylvania will be asked to establish a School of Forestry.

Professor Luther Foster has resigned his position of vice-director of the experiment station and professor of agriculture in connection with the University of Wyoming at Laramie, in order to accept the presidency of the New Mexico College of Agriculture and Mechanic Arts located at Mesilla Park, and the directorship of the agricultural experiment station at the same place. Professor Foster was elected to his new position unanimously by the board of regents of the college and station on November 22, and assumed charge of the duties of the position on December 1.

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 10, 1902.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE AMERICAN SOCIETY OF NATURALISTS.

THE CHICAGO MEETING.

THE meetings of the American Society of Naturalists and of the affiliated societies held last week in Chicago were not only important for the scientific work presented, but were also noteworthy as marking an epoch in the organization of science in America. The nineteenth century is regarded on all sides as the era of science. It was also an era of individualism in science, as in business and in political institutions. Historical developments do not usually occur to fit the calendar, but it has so happened that the first year of the present century has witnessed in America an extraordinary advance toward that organization of science and that cooperation among scientific men, which will probably be typical of the century.

The American Association for the Advancement of Science met last August in Denver, passing for the first time beyond the banks of the Mississippi, and becoming national in fact as well as in name. The Association also became at the Denver meeting truly representative, not only of the whole country, but also of all the sciences, by its action in making its council the representative body for all our scientific societies. Equally important in this direction was the decision to meet next year at Washington in midwinter, making it possible for all the scientific societies to come together in a great national congress. The success of the Association in securing the adhesion of our leading institutions of learning to convocation week, thus obtaining an excellent time for the meetings, must also be regarded as an event of great moment.

As the American Association met for the first time in the western half of the country, so the American Society of Naturalists met this year for the first time west of the eastern seaboard. Joining with the naturalists of the Central and Western States the society became truly national in character. Equally important was the decision of the society to meet next winter at Washington in conjunction with the American Association—a step taken not only by eastern naturalists, but also by those of the Central and Western States. The congress next year at Washington will bring together the societies that have hitherto been divided between summer and winter meetings, and will thus represent the entire domain of science, as well as the whole country. It will be a meeting from which no scientific man can afford to absent himself, while its magnitude will give science a position before the national government, before our educational institutions and before the general public that it has never hitherto obtained.

The subject chosen for discussion at Chicago was 'The Relation of the American Society of Naturalists to other Scientific Societies'—a topic obviously fitted to the occasion. The result of the discussion was most satisfactory in demonstrating the desire of those representing different sciences and different regions of the country to cooperate for the common good. The speakers from the Eastern States, Professors Minot, McGee and Cattell, tended to emphasize the importance of national union, whereas the speakers from the Central States, Professors Davenport, Trelease, Birge and Forbes, laid special weight on the need for local centers; but all agreed that we must have a strong central organization with a great annual meeting, while at the same time we must provide local and sectional meetings for those unable to attend the general congress, and also for the purpose of having groups not too large for adequate discussion. There was a unanimous sentiment that arrangements should be made by which the more local societies and meetings should not rival, but support the central organization. Committees were appointed by the American Society of Naturalists, and the Naturalists of the Central and Western States to cooperate in formulating plans for future meetings, and, as has been stated, the western naturalists decided to meet next year in Washington.

No less timely than the annual discussion, was the address of the president, Professor Sedgwick, on 'The Modern Subjection of Science and Education to Propaganda, printed in the present issue of Science. The usefulness of a society such as the Naturalists is well indicated by an address of this character, stating in a semi-official way the consensus of opinion of scientific men on a topic of great concern to the whole people. For this address, and for his leading part in the arrangements for the Chicago meeting, Professor Sedgwick has the thanks of all naturalists. The lecture by Dr. Howard, like the president's address, was a model of what the occasion required. The subject 'International Work with Beneficial Insects' was of interest to all, and the treatment was neither technical nor trivial.

The local arrangements were admirable. The University of Chicago offered every possible facility for the meetings. President Harper welcomed the societies and entertained them at his house. The local committee, headed by Professors Davenport and Jordan, left nothing undone. The hotel headquarters were probably the best ever provided, and the dinner—attended by two hundred members, fifty more than at any previous meeting—was excellent, from the point of view both of the physiologist and of the psychologist. There were no speeches except the president's address, but after the official adjournment, most of those present lingered for an hour or two in pleasant social groups.

Three hundred and three scientific men registered, and there were doubtless some who omitted this formality. The meeting was the largest in the history of the Society, and nearly as large as the meetings of the American Association when it meets in the Central States. The attendance from the Eastern States was very satisfactory, though the journey naturally prevented the attendance of many of the younger men. The Central States, including Iowa, Nebraska and Missouri, were very fully represented.

The number of papers announced on the preliminary programs of the affiliated societies—considerably increased at the time of the meetings—was as follows: American Morphological Society, 50; American Physiological Society, 43; Association of American Anatomists, 31; Society of American Bacteriologists, 35; Botanists of the Central and Western States, 28; American Psychological Association and Western Philosophical Association, 23; Section H, Anthropology, of the American Association, 16. Adding the addresses and discussions before the Naturalists, there were thus 244 scientific papers on the preliminary programs, probably the largest number presented at any meeting of the Naturalists, and equalling the number usually presented at the meetings of the American Association. Either the official proceedings or full reports of the meetings of the different scientific societies will be published in subsequent issues of this journal.

The Council of the American Association held a well-attended meeting. The permanent secretary, Dr. Howard, made a report showing that the number of members has greatly increased during the year, and that the finances are in good condition. The membership at the end of the year was over three thousand, and the initiation fees of the new members had more than defrayed the cost of sending SCIENCE to all members. The committee on convocation week presented the report published in the issue of this journal for December 27, showing that both our institutions of learning and our societies are unanimously cooperating in setting aside for the meetings of learned and scientific societies the week in which the first day of January falls. A committee was appointed to consider the question of the duty imposed on scientific apparatus imported for educational institutions, a resolution was passed advocating a national health service, and other business was transacted. The most interesting feature of the meeting was perhaps the representation of Section K, Physiology and Experimental Medicine, by its first officers, Professors Welch and Lee. It was decided that the first meeting of the Section should be held in Washington a year hence, and that all scientific papers must be presented through one of the national societies devoted to the sciences falling within the scope of the Section.

While the affiliated scientific societies devoted to the biological sciences were meeting in Chicago, the other scientific societies that hold winter meetings were in session in different cities. The American Geological Society met in Rochester, the American Chemical Society in Philadelphia, the Astronomical and Astrophysical Society of America in Washington, the American Mathematical and Physical Societies and the eastern branch of the Society for Plant Morphology and Physiology in New York. So far as can be judged from the preliminary programs and from accounts that have reached us, the meetings were in all cases successful, and this will doubtless be fully proved by the reports that will be published in this journal. It will, however, be a gain to the separate societies and especially to science as a whole when all our men of science gather in one congress as will be the case next year.

Only those who have attended the meetings of our scientific societies in recent years can fully appreciate the improvement that has taken place in the conduct of the meetings, the increase in the volume and value of scientific work, and the friendly and cordial relations almost universal among scientific men. We are entitled to enjoy great satisfaction in the advances made by the Denver and Chicago meetings, and to look forward with sure anticipation of a further advance in the great meeting to be held during convocation week next winter at Washington.

THE MODERN SUBJECTION OF SCIENCE AND EDUCATION TO PROPAGANDA.

One of the sad pages in the history of science and education is that which relates how, on the death of Alexander the Great, the teacher of his youth, the much greater Aristotle, rightly regarded by the Middle Age as the 'master of those who know' when more than sixty years old was driven from Athens into exile by a patriotic propaganda of the anti-Macedonians. A darker and a bloody page tells how Hypatia of Alexandria, the beautiful and learned daughter of Theon, was cruelly and brutally murdered in a Christian church in the year 415 of our era as a victim of a fanatical propaganda against paganism, condoned, if not conducted, by the Christian Archbishop Cyril, Patriarch of Alexandria. Copernicus hesitated long before publishing his splendid discoveries on the movements of the heavenly bodies and the heliocentric theory, for fear of ecclesiastical interference, and when soon after Galileo, more bold, promulgated the truth that Copernicus had hesitated to pronounce, both he and his discoveries fell under the severest ecclesiastical condemnation ever visited upon any man of science for the truth alone.

In our own time we have too often heard of sects which place the propaganda of a special faith before either science or education, and inquire more carefully into the orthodoxy of professors and pupils than into their scientific or educational attainments. However much we may regret such action we cannot legitimately complain so long as the sectarians in question confine their actions to sectarian schools, colleges and universities, supported exclusively by private means, for the right to regulate education within the home, the family, the private school or the private college or university, is a fundamental and inalienable right of a well-regulated democracy.

The century just closed has witnessed a remarkable liberation of natural science and education from dogma. Geology was first set free by Lyell and his school, and then biology, by the discoveries of fossil man, and the splendid inductions of Darwin. Slowly but surely the teaching of natural science, which, like all teaching, follows closely in the footsteps of discovery, has also cast off its chains and freed itself from the subjection of theology. But as the church has declined in temporal power the state has become supreme, and with the recognition of its power has come the belief in its sufficiency,—even its sufficiency to remedy all ills, real or imaginary,—and scarcely had science and education freed themselves from the bonds of the church before they began to be threatened with subjection by the state, a subjection sought for not by theologians but by philanthropists and philozoists.

The first in the field were the philozoists, commonly known as anti-vivisectionists. In former times charges of cruelty brought against scientific men would have been referred to an inquisition when such an institution existed but now, the church being powerless in such matters, appeal must be had to the state. Accordingly, a propaganda was started, first, so far as I am aware, in England but afterwards spreading to this country, which by 1875 had succeeded in bringing into complete subjection in Great Britain animal physiology, then the principal experimental biological science. Since that time a new biological science, bacteriology, has sprung up and found itself hampered also in some of its most important and most humane investigations by the same British statute, enacted on demand of the philozoic propaganda.

Anyone may read in the 29th chapter of the admirable Life and Letters of Professor Huxley, edited by his son, how, in 1870, when president of the British Association, Huxley had been violently attacked for speaking in defence of Brown-Séquard, the French physiologist, and how in the same year a committee had been appointed by the British Association, and reported upon the conditions under which they considered experiments on living animals justifiable. When legislation seemed imminent Huxley, in concert with other men of science, interested himself in drawing up a petition to Parliament to direct opinion on the subject and provide a fair basis for future legislation. A Royal Commission was finally appointed, with Huxley as one of its members. Early in 1876 the Commission reported and a few months later Lord Carnarvon introduced a bill entitled 'An Act to amend the Law relating to Cruelty to Animals.' "It was," says Mr. Leonard

Huxley, "a more drastic measure than was demanded. As a writer in *Nature* (1876, page 248) puts it, 'The evidence on the strength of which legislation was recommended went beyond the facts, the report went beyond the evidence, the recommendation beyond the report, and the bill can hardly be said to have gone beyond the recommendations, but rather to have contradicted them.'"

As to the early working of this law Huxley remarked in the following year in his address on 'Elementary Instruction in Physiology' as follows ('Coll. Essays,' III, 310):

"So it comes about that, in this year of grace, 1877, two persons may be charged with cruelty to animals. One [a fisherman] has impaled a frog, and suffered the creature to writhe about in that condition for hours; the other [a teacher] has pained the animal no more than one of us would be pained by tying strings round his fingers, and keeping him in the position of a hydropathic patient. The first offender says, 'I did it because I find fishing very amusing,' and the magistrate bids him depart in peace—nay, probably wishes him good sport. The second pleads, 'I wanted to impress a scientific truth with a distinctness attainable in no other way on the minds of my scholars,' and the magistrate fines him five pounds. I cannot but think that this is an anomalous and not wholly creditable state of things."

Looking back over more than twenty-five years of the practical working of this law we can affirm without hesitation that under its operation both physiological science and physiological education have been kept by the State, or rather by the propaganda which secured the passage of the statute, under a needless and injurious subjection.

As early as 1865, and apparently before the scientific men of Great Britain had seriously begun to oppose the anti-vivisection propaganda, Dr. John C. Dalton, Professor of physiology in the College of Physicians and Surgeons in New York City, delivered an address before the New York Academy of Medicine, which, for lucidity of statement, dignity of tone, wisdom and high seriousness, seems to me superior to any treatment of the subject with which I am familiar ('Vivisection: What it is, and What it has Accomplished.' Address before the New York Academy of Medicine, December 13, 1866). Many of Dr. Dalton's definitions and illustrations are worthy of quotation, *e. g.*:

"The subject of discussion is not vivisection in its narrowest sense, but the entire method of experiment upon living animals as a means of study in physiology and the kindred sciences" (p. 5).

"Experimental vivisection is no more open to the charge of cruelty * * * than the dissection of human bodies for the study of anatomy is open to the charge of sacrilege and impiety. * * * (P. 2.)

"We might as well expect to learn the phenomena of magnetism by experimenting with subjects not magnetic, as to study the phenomena of life anywhere but in the actions of the living body." (P. 7.)

Dr. Dalton published further in 1875 'Experimentation on Animals as a means of Knowledge in Physiology, Pathology and Practical Medicine,' and I cannot help feeling that it was largely his calm, fair and yet firm, attitude that caused the failure of the anti-vivisection propaganda in the State of New York in 1867 and again in 1874.

In Massachusetts repeated attempts have been made to secure legislation 'regulating' vivisection. An anti-vivisection propaganda is constantly maintained in Boston, and for several successive years bills aiming at the 'restriction' or 'regulation' of vivisection have been introduced into the legislature by the propagandists, but, having been vigorously opposed by medical and scientific men powerfully aided by such public-spirited citizens as the president of Harvard University, the president of the Massachusetts Institute of Technology and the Bishop of Massachusetts, they have hitherto failed ignominiously. All sorts of restrictions have been suggested, and in the latest bill it was proposed to endow the agents of any society for the prevention of cruelty to animals with powers of entrance and search, so that they might visit any laboratory at any time, taking names and otherwise interfering with the freedom of research and instruction, as well as infringing upon the individual liberty of persons engaged in experimentation upon animals. If such a law had been passed, the subjection of science to propaganda in Massachusetts would to-day be even more complete and more intolerable than it has been in England since 1875.

I need not recount the recent attempt of those engaged in this propaganda to secure restrictive legislation for the District of Columbia. Suffice it to say that the attempt was one of the boldest and most dangerous attacks upon the freedom of research which has ever been made in America.

Nor is this all. Some of those engaged in the anti-vivisection propaganda seek, at the same time that they would abolish vivisection, to do away with all dissection of whatever sort in public schools of whatever grade. No one in his senses desires vivisection in the public schools except, perhaps, in normal schools devoted to the education of teachers. But dissection of clams, oysters, lobsters, starfish, sea-urchins, worms, snails and possibly fishes and frogs, are not only not necessarily out of place but may even be very useful and desirable in high schools and normal schools. My own feeling is that in grammar schools and all schools lower than high schools instruction should be confined almost wholly to the external structure of plants and animals, with their occurrence, habits, habitats and the like; but I see no good reason why in high schools and normal schools the elements, at least, of the internal structure of invertebrates and even of certain vertebrates may not well be taught. I have taken some pains to secure upon this point the opinion of a number of teachers of natural science in normal schools, most of whom have also been teachers in schools of lower grade, and with one or two exceptions I find that they are strongly of the opinion that a moderate amount of dissection is not only desirable but almost indispensable.

Yet in 1895 the American Humane Association published in Chicago a report on vivisection and dissection in public schools, in which various excellent persons unhesitatingly affirmed that dissection in public schools is superfluous, and that physiology can be well enough taught by means of manikins, pictures and the like. In particular, several bishops, apparently regarding themselves as qualified to give evidence on this subject, stated without hesitation that all that is necessary in the practical teaching of physiology is illustrated books, manikins, etc., some even going further and saying that dissection must inevitably blunt the sensibilities and corrupt the character of the young. Cardinal Gibbons, of Baltimore, however, was more cautious when he said: "I am inclined to think that sufficient instruction can be imparted by the use of illustrations and manikins. I think it advisable to give children the knowledge, as Scripture does, of the God-given power of man over the lower forms of life; but they should be warned that this power is not absolute, arbitrary or cruel." In reading the pronouncements of the American bishops referred to, one is reminded of the occasions for Huxley's frequent and contemptuous sneers at the bishops of his own land with whom he so often did battle with delight.

As a specific illustration of the need of watchfulness concerning the privilege of dissection in the public schools I may cite what took place in Boston a few years ago. Those who happened at the time to be living in that city awoke one morning in January, 1894, to find that on the previous evening a member of the Boston School Committee had offered the following order and that it had been unanimously passed.

"Ordered: That the dissection of animals be prohibited in the public school buildings of the city of Boston."

Realizing how damaging a rule of this sort must inevitably be to the best interests of science in the public schools, I hastily drew up the following petition to the School Committee and secured for it the signatures of President Eliot, General Walker, Professor Agassiz and a few other leaders in science or education in or near Boston:

"To the School Committee of the city of Boston:

"We have learned with surprise and regret of the prohibition which you have placed upon the dissection of animals in the public school buildings of Boston. We earnestly protest against this action and urge its immediate reversal, believing that such a prohibition will seriously weaken the efficiency of science-teaching in the schools and completely cripple the courses in zoology and physiology. As the order stands, no one, not even a head-master, is allowed to dissect, in any of the school buildings, so much as a fish or an oyster."

(Signed) Charles W. Eliot, Francis A. Walker, A. Agassiz, Mrs. Louis Agassiz, Josiah P. Cooke, Augustus Lowell, Alice Freeman Palmer, Samuel Eliot, Mary Hemenway, Mrs. W. B. Rogers, H. P. Bowditch.

I also took pains to make the matter known through the press, and the result was that at the next meeting of the School Committee the order was reconsidered, amended and finally passed in a less objectionable form, as follows:

"Ordered: That dissection of red-blooded animals be confined to normal and high schools when approved by the superintendent and masters."

This perhaps is as good a place as any in which to urge upon all those within sound of my voice, or before whom this subject may come upon the printed page, and who desire to keep intact the freedom of science and education, the necessity of watching, in season and out of season, to repel the attacks of that propaganda which would not only compel all practical instruction in physiology to be based upon pictures and manikins, but would also prohibit altogether all experimentation upon animals, whether in physiology, bacteriology or experimental medicine. Science in Great Britain, as has already been stated, has been brought under an almost intolerable subjection by the anti-vivisection propaganda. In America, though long threatened, this has not yet come to pass; but unless naturalists everywhere are on their guard they will some day be taken by surprise, very much as the English naturalists seem to have been, and be brought under a similar subjection to the same hostile propaganda.

But if in America we can rejoice that we have thus far resisted the onslaughts of philozoists upon experimental science, we must confess with sorrow that we have been less fortunate in dealing with philanthropists, in an important department of elementary education. When, in 1842, Horace Mann published his still excellent essay on 'The Study of Physiology in Schools,' he seems, judged by recent school statutes of the several United States, to have made one serious omission, for he nowhere mentions or even foreshadows that remarkable creation of our own times, 'temperance physiology,' and very likely, with some old-fashioned people of to-day, he regarded 'temperance' as chiefly a moral question.

The discovery of this new and entirely modern branch of 'science' and 'education' seems to have been the joint work of Dr. (afterwards Sir) Benjamin W. Richardson of England, an able but erratic physician, and Mrs. Mary H. Hunt, formerly of Hyde Park, Massachusetts, and now of Boston. At any rate, Mrs. Hunt refers to Dr. Richardson as the author from whom she drew some of her original inspiration, but her own achievements, in organizing and directing the propaganda now associated with her name, have so far outrun anything done for it at the outset by Dr. Richardson that we must regard her, and not him, as the true creator of this astonishing movement. Mrs. Hunt says that her mind was turned to the subject in the early seventies and that she soon found in Dr. Richardson's 'Cantor Lectures on Alcohol in its relation to Man,' the exact data she had been groping for. These lectures seemed to her to prove 'the dangerous difference between the demonstrated fact that it is the nature of a little alcohol to create an uncontrollable appetite for more, and the popular idea of the harmlessness of using alcohol in small quantities,' and the corollary seemed to her to be 'that intemperance could never be prevented until the people were taught to really know the effects of alcoholic drinks, and that this must be done through the schools.' From 1880 until the present time this really remarkable woman has given her life with intense devotion and extraordinary success to a national, and even world-wide, propaganda of her faith.

The movement is variously called 'scientific temperance instruction,' 'temperance physiology' or 'physiological temperance,' and it has now grown to such proportions and has gained such power as to dominate, almost absolutely, all instruction in elementary physiology and hygiene in America. It is of course right and proper that pupils in all grades of the public schools should be taught the dangers of alcoholic beverages as fully and as earnestly as other dangers lurking in food or drink. We may even grant that more stress should be laid upon this subject than upon some others. But an examination of the present status of elementary education in physiology and hygiene in the United States shows that in many cases the instruction demanded by this propaganda, and given according to law, in reference to alcohol goes much further. It even appears that all instruction in physiology and hygiene in the public schools has passed to a great and unjustifiable extent into the virtual control and under the subjection of the 'temperance physiology' propaganda. Mrs. Hunt, as early as 1888, boldly announced: "We are the recruiting officers, and the teachers the drill-masters, for training the coming total-abstinence army that is to banish alcohol from human beverages."

Authoritative sources of information for testing these statements are easily accessible to all. They consist of the statutes of the several States requiring instruction, often of prescribed and peculiar kinds, regarding alcohol; of the text-books on elementary physiology and hygiene actually in the hands of the pupils; of the teachers,— many of whom groan in spirit even when they do not dare to complain openly; and last, but not least, of the boastful 'histories' of the propaganda prepared by Mrs. Hunt herself and published, one in 1891 (or earlier) and the other in 1897.*

*1. 'A History of the First Decade of the Department of Scientific Instruction in Schools and Colleges of the Woman's Christian Temperance Union.' By Mary H. Hunt, Superintendent for the United States and the World's W. C. T. U. Second Edition. Boston, 1891.

From these latter it appears that largely through her personal efforts statutes now exist in nearly every one of the United States requiring instruction in physiology and hygiene with special reference to the nature and effects of alcoholic drinks; that in some states a penalty clause is attached for non-enforcement; that in some the amount of space to be given in text-books is prescribed, and in the same or in others, the time to be devoted to the subject. In some States it is also required that the subject shall not be treated in an appendix, or in a separate chapter at the end of the book.

In 1897 Mrs. Hunt stated that 'a combination of the Illinois law with the penalty [clause] of the New York law would be an ideal statute.' It is therefore easy to see at what she aims, for the Illinois law requires that all pupils 'below the second year of the high school and above the third year of school work' counting from the lowest primary, 'shall be taught and shall study this subject every year, from suitable text-books in the hands of all pupils, for not less than four lessons a week, for ten or more weeks of each year.' For students below the high school 'such text-books shall give at least one fifth their space,' and for high-school students "not less than twenty pages, to the nature and effects of alcoholic drinks and other narcotics. The pages on this subject in a separate chapter at the end of the book shall not be counted in determining the minimum." The New York law of 1896 is very lengthy and likewise contains an important provision that 'this subject must be treated in the text-books in connection with the various divisions of physiology and hygiene, and pages on this subject in a separate chapter at the end of the book shall not be counted in determining the minimum.'

The effect of these peculiar laws closely defining instruction in physiology and hygiene has been to create a correspondingly peculiar class of text-books. Some of these have been prepared by competent writers, but most of them are inferior and some are distinctly bad. One chapter in Mrs. Hunt's 'History' is entitled 'The Text-Book War.' It is not agreeable reading, either for scientific men or for educators. In a so-called 'Great Petition to Publishers,' which reads more like a threat than a petition, it is stated: "This is not a physiological, but a temperance, movement. In all grades below the high school this instruction should contain only physiology enough to make the hygiene of temperance and other laws of health intelligible. Temperance should be the chief and not the subordinate topic, and should occupy at least one fourth the space in text-books for these grades." In the same 'Great Petition to Publishers' we find it also stated that "Those text-books that are largely physiology with a minimum of temperance matter * * * do not meet the requirements of the law, and do not satisfy those who secured its enactment, and *are determined to secure its enforcement.*" Further on, publishers are told exactly what is wanted, in great detail and in no uncertain tones.

Text-books conforming with these requirements of the propaganda may be officially 'indorsed' by a 'Committee of the Advisory Board' sitting in council for the purpose. In another chapter, entitled the 'Text-book War Over,' it is stated that 'in response to the Great Petition most of the publishers have expressed the desire to have their books revised, on condition that the National Superintendent of the Scien-

2. 'An Epoch of the Nineteenth Century. An Outline of the Work for Scientific Temperance Education in the Public Schools of the United States.' By Mary H. Hunt, National and International Superintendent of the Department of Scientific Temperance Instruction, and Life Director of the National Educational Association. Boston, 1897.

tific Department of the Woman's Christian Temperance Union would revise them or supervise their proposed revision.' That is to say many publishers were naturally eager to have their books 'indorsed' by Mrs. Hunt, doubtless hoping thereby to increase their sale. On August 10, 1888, Mrs. Hunt 'with secretaries and helpers returned to Hyde Park, Massachusetts and opened again 'Hope Cottage' which became the local base of operations for text-book revision.' "That these revised books might be distinguished at a glance from the unrevised and unworthy books a committee was chosen * * * to indicate upon each its character. * * * The position of the chairman (Mrs. Hunt) of this committee chosen to extend the indorsement to school text-books of this kind in behalf of the signers of the Great Petition to Publishers and of the Woman's Christian Temperance Union has proved a very trying one and a most severe test of loyalty to principle."

I may remark in passing that one is frequently reminded in Mrs. Hunt's 'histories' that the United States Commissioner of Education is, or was, a member of the Advisory Board which has conducted this remarkable propaganda. As to the propriety of the Commissioner's connection with this movement I make no comment.

It would be tedious, though not uninstructive, to give many more quotations from the extraordinary documents which recount the history of the 'scientific' temperance movement. Those who desire to inform themselves more fully should not fail to consult the original authorities referred to above. As an illustration of the almost hysterical scenes accompanying the work of securing favorable legislation by this particular propaganda, I cannot forbear quoting the 'Report of an Eyewitness' describing the passage of the Pennsylvania law: "As the work of widening the temperance sentiment goes on we come now and then, would that it were more frequently, to the place where the only thing to do seems to be to raise an Ebenezer, and the only thing to say is 'Hitherto hath the Lord helped us.' * * * Upon a great tide of womanly support that buoyed her up on wave after wave of prayer and of faith in her powers, has the leader of this work (Mrs. Hunt) been borne from city to city like a brave ship, laden with the treasure of knowledge and blessing to be spread out before the listening people. * * *" Then follows a description of the State Capitol, and of the gathering legislators, of their good-natured reception of Mrs. Hunt, of her address and its effect, after which the writer passes on to the opening of a following session: "Almost before the amen of the opening prayer had been uttered, a dozen members were on their feet offering the petitions sent in from their various districts in behalf of the bill for 'scientific temperance education'; the dozens swelled to scores, and the scores multiplied all in a moment, until so many boy-messengers were flying down the aisles with the papers, and so many arms were waving in the air, that from every seat there seemed suddenly to have sprung a great, fluttering, white blossom of petition. * * * I make no mistake when I call Mrs. Hunt the mother of the bill. * * * Behind this mother of the bill stood some of those who have borne it so closely upon their hearts that they may properly be called its god-mothers, its sisters, its cousins and its aunts." The bill was passed and signed by the Governor and the writer remarks, 'It was a God-given victory and to Him be all the praise.'

One of the humors of the passage of a national law requiring 'scientific' temperance instruction at West Point, at Annapolis, in the District of Columbia and for all schools under Federal control, was a debate in the Senate in which "A certain senator declared that 'rum-sellers or patrons of rum-sellers have as good a right to have their views on temperance education printed by the National Government as any woman.' * * * The following extract," says Mrs. Hunt, "from a letter a lady from his own State wrote that senator is a fair illustration of the reception his ideas received among his constituency: 'When I knew you, sir, in our state, you were a chivalric Southern gentleman. Imagine my indignation at the audacity of the reporter who dares to report you as saying that "liquor men have as good a right to be heard in the Congress of the United States on the education of the children as any lady. * * * I am sure you must be misrepresented, for no man who would say such a thing in the national Senate could represent a white man's government from this State.'" 'Many such letters,' adds Mrs. Hunt, 'reached that senator, and thus his opposition died.'

No wise educator who has given any attention to the subject can deny that the influence of this powerful propaganda has been in most respects injurious to the proper teaching of physiology and hygiene in the lower schools. Teachers, principals, superintendents, and even school committees, are seldom able to speak with perfect frankness on the subject, from fear of the influences which may be brought to bear against them or of the intemperate criticism to which they may be exposed; and in my opinion it is time for a body of scientific men like the American Society of Naturalists or the American Association for the Advancement of Science to put on record its opinion that the subjection under which science and education are to-day suffering from the 'temperance physiology' propaganda has become intolerable.

I lately examined with some care a good text-book of elementary physiology and was shocked on opening it to find at the very beginning, and in a most prominent place, an entire page devoted to an 'indorsement' of the book by the self-constituted oligarchy which has the assurance to 'approve' or not, as it sees fit, text-books on physiology and hygiene for use in secondary and lower schools. In the case I mention this committee did not even confine their 'approval' to the alcoholic and narcotic portions of the book but 'indorsed' also its 'amount of matter on general hygiene,' as well as the 'presentation of matter with regard to its adaptability to the class of students for which it is designed'; or, in other words, passed upon its scientific and pedagogical merit, as well as upon its alcoholic value. If, as would sometimes seem to be the case, it has actually come to pass, at the beginning of this twentieth century, that a writer who desires to publish an elementary text-book on physiology and hygiene, before he can obtain a publisher or a market, may have to secure the 'indorsement' of 'Mrs. Mary H. Hunt, World's and National Superintendent of Scientific Temperance Instruction of the Woman's Christian Temperance Union,' of 'the Rev. Daniel Dorchester, D.D., Vice-President of the Massachusetts Total Abstinence Society,' and the rest of this self-constituted committee, it is high time that cognizance should be taken of the fact by scientific men and educators and a protest entered.

On further examining the book to which I have just referred, I was even more disturbed to find that this author, like some other recent writers on elementary physiology and hygiene, doubtless with the New York law before his eyes (which requires that 'this subject must be treated in the text-books in connection with the *various divisions* of physiology and hygiene, and pages on this subject in a separate chapter at the end of the book shall not be counted') had actually felt bound to weave in a lesson on alcohol with his discussion of the physiology of muscle, of nerve, of digestion, of vision, and each of several other sections of the subject, so that all his work seemed literally tainted with alcohol.

It is a notorious and a disgraceful fact, that, apparently with a view of pleasing this self-constituted oligarchy, some writers have even made alcoholic instruction the beginning, the middle, and the end, of their text-books. Of such books it may truly be said that they have no permanency of their own, and are only with difficulty preserved by alcohol.

What I have said thus far of this subject applies mainly to elementary education; but those who have witnessed the virulent attacks upon a conscientious chemist and physiologist, who has recently made important physiological experiments upon the oxidation of alcohol within the human body, because his experiments have seemed to confirm the earlier statements that alcohol in minute quantities is more like a food than a poison, do not need to be told that this same propaganda is quite as eager to bring science, as it has already brought education, under its powerful dominion. Signs are not wanting, however, which indicate that its control has already reached its climax, and even begun to decline.

An attempt in 1899 on the part of Mrs. Hunt and others to make the Massachusetts law conform more closely to the ideas of those interested in 'scientific temperance' was stoutly resisted by the Massachusetts Medical Society, as well as by various scientific men and educators, with the result that the statute of 1885 remains unchanged. This prescribes that 'physiology and hygiene, which in both divisions of the subject shall include special instruction as to the effect of alcoholic drinks, stimulants and narcotics on the human system, shall be taught as a regular branch of study to all pupils in all schools supported wholly or in part by public money, except special schools maintained solely for instruction in particular branches, such as drawing, mechanics, art and like studies.' With the exception of the clause 'to all pupils' this statute is not unreasonable, for, as I have said above, it is right and proper that the youth of the land should be taught, plainly and thoroughly, the dangers which lurk in alcoholic drinks, in narcotics, etc. What is unnecessary and objectionable is that the exact amount of such teaching should be prescribed by law; and that the method of teaching (by text-books in the hands of the pupils), the space devoted to it, and its treatment, in text-books, should be legally regulated. That, in addition, the particular text-books used should be largely determined by a self-constituted and unofficial oligarchy, leaders of a propaganda, which, in any right use of the terms, is neither educational nor scientific, is both odious and intolerable.

In Connecticut, in 1901, a statute of the objectionable sort referred to above was repealed, and one to which but little exception can be taken was enacted in its place. It is gratifying to note, also, that the Department of Superintendence of the National Educational Association, at a meeting in Chicago in the early part of the same year, adopted a report containing the following significant, if guarded, paragraphs:

"The questions of highest importance for teachers and superintendents of schools to consider [concerning 'temperance physiology'] are those which relate to the methods by which temperance instruction shall be imparted, the extent to which it shall be carried, and the subject-matter to be presented.

"The educational side of this question is vitally important, and demands thorough and systematic study.'' This action is timely and welcome in view of the existence of an opinion like the following, expressed in a letter to me by a representative of a prominent publishing house: ''I feel that we can not be too emphatic in expressing sympathy with your movement and in denouncing the intimidation of teachers and other educators which has gone on for some years. The whole so-called temperance physiology movement of the W. C. T. U. seems to have fallen into the hands of blackmailers and schemers, who pull the wool over the eyes of the rank and file of the organization, and work both schools and publishers for their own financial benefit. You are quite right in saying that the school teachers are 'bullied'; they are, and they do not dare resent such action as it should be resented.''

Time fails to deal, as I would be glad to do, with other forms of propaganda which seek to bring under their special subjection various departments of science or education. One of these is that known as the anti-vaccination movement, which is widely supported not only in England, but of late also in America, and has already succeeded in both countries in modifying very materially those requirements of compulsory vaccination indicated by science, experience and common sense. It is true that compulsory vaccination should be undertaken only after the most careful consideration, for it constitutes a serious trespass upon the fundamental right of personal and individual liberty. But I have no idea that this movement will ever seriously subvert the cause of vaccination, for the reason that a lively epidemic of small-pox will generally bring the majority of the people to their senses, and such epidemics are tolerably sure to come if anti-vaccinationists become too numerous or too active. I must, however, enter a protest against those medical practitioners who after merely prescribing powders for children give them certificates of 'vaccination' which will enable them to attend the public schools. Such lying and deceit merit only the condemnation and contempt of all lovers of science and truth.

Naturalists should also be on their guard against the influence of that new but rapidly growing sect, known as Christian Scientists, which virtually denies the existence of disease and accordingly, logically enough, disapproves of all teaching of physiology and hygiene. It has recently come within my own knowledge that a Christian Scientist refused to attend a lecture on domestic economy by an expert because the latter happened to be at the time attending a meeting of the American Public Health Association, alleging that no one could be worth hearing on the subject appointed who had anything to do with an Association devoted to a purpose so useless.

With propagandists besieging more or less successfully our halls of legislation, the time has come when bodies like the American Society of Naturalists and the American Association for the Advancement of Science should have standing committees on legislation, to take care, as far as possible, that unwise, extravagant or fanatical ideas regarding science and education shall not be given the force of law by the several States or by the Federal Congress.

If to-day we have little to fear from dogma or theology we may still have much to dread from foolish or needless legislation; and I desire to urge upon all those to whom these words may come, the duty, alike of individual watchfulness and of united effort, to resist everywhere and always the statutory subjection of science and education to propaganda.

William T. Sedgwick.
Mass. Institute of Technology.

A SUMMER'S DREDGING ON THE COAST OF SOUTHERN CALIFORNIA.*

A CONSIDERABLE piece of marine biological exploration was carried on along the coast of southern California during the past summer by the Zoological Department of the University of California. This was made possible financially by the augmentation of University funds that could be devoted to the undertaking chiefly through the efforts and generosity of Mr. H. W. O'Melveny, Mr. J. A. Graves and Mr. Jacob Baruch of Los Angeles; but to numerous other gentlemen and ladies of that city the warmest thanks are due both for financial assistance and for intelligent interest in and encouragement of the work.

The purpose of the undertaking was investigation. As, however, a little formal teaching could be done without greatly increasing the expenditure or hindering the main work of the summer, it was thought best to offer a few courses of instruction. Three of these were consequently given. One in general marine zoology, one in physiology, and a third for students sufficiently advanced to work under guidance on special problems.

The scientific staff, all from the University of California, consisted of:

William E. Ritter, Ph.D., Associate Professor of Zoology, in charge.

J. W. Raymond, B.S., Assistant Professor of Physics, Hydrography and Conchology.

C. A. Kofoid, Ph.D., Assistant Professor of Histology and Embryology, Zoology and Hydrography.

F. W. Bancroft, Ph.D., Instructor in Physiology.

H. B. Torrey, M.S., Instructor in Zoology.

Alice Robertson, M.S., Le Conte Fellow in Zoology. In charge of the collections.

In addition there were present at the laboratory for longer or shorter periods during the summer, for the prosecution of independent studies:

Mr. W. C. Adler-Mereschkowsky, a Russian diatomist, now of Los Angeles.

T. D. A. Cockerell, Entomologist of New Mexico Agricultural Experiment Station, East Las Vegas, New Mexico.

W. R. Coe, Ph.D., Assistant Professor of Zoology of Sheffield Scientific School, Yale University.

S. J. Holmes, Ph.D., Instructor in Zoology, University of Michigan.

Miss Sarah I. Monks, Instructor in Zoology, State Normal School, Los Angeles.

Miss G. R. Crocker, graduate student, University of California.

Mrs. Ida Oldroyd, Los Angeles, California.

Fourteen persons, mostly teachers of biological subjects in colleges and high schools of California, were enrolled in the elementary courses.

In view of the importance of the field, and the meagerness of previous investigations in it, it seemed best to plan the summer's work as though it were to be the beginning of a detailed biological survey of the coast of California, even though no assurance could be had of the possibility of continuing the work beyond this season.

Such a survey would of necessity comprehend the investigation, not merely of the life of the area, but as well of the physical conditions under which it exists. It would have to be hydrographic as well as biological. The limitations of the equipment and the force of workers determined what might be undertaken for the summer. Soundings, temperature and specific gravity determinations, and the character of

*A portion of the Preliminary Report to the President of the University of California on the Marine Biological Explorations conducted by the Zoological Department of the University on the coast of southern California, during the summer of 1901.

the bottom were practicable on the hydrographic side. Current investigations, fundamental in importance as they are, could be prosecuted to but a very limited extent.

The dredge and trawl were chiefly relied upon in the collecting. For various reasons it was found both impracticable and unwise to attempt deep plankton work to any considerable extent; neither could surface plankton collecting be extensively carried on, though the limited efforts in this direction were productive of interesting and valuable results.

Both the hydrographic and the biological explorations were extended from the shore line to the hundred-fathom curve. The general purposes of the summer's undertaking dictated that the explorations should be carried out with as much accuracy and detail as possible within these bathymetric limits, and that the geographical range over which they should extend should be made secondary to this aim. San Pedro was selected as the base of operations, on account both of its central location in the area to be surveyed and its natural advantages as a site for a marine station. The plan was to explore the coast immediately contiguous to this place and then extend the work to the south and north as far as the time would permit. It was hoped before operations began that they might reach to San Diego at the south, Point Conception at the north and various of the islands off the coast. Experience proved, however, the impossibility of accomplishing so much. The areas actually covered are about thirty miles of coast in the vicinity of San Pedro, viz., from Redondo pier on the northwest to Newport Bay on the southeast; around Santa Catalina Island; and the vicinity of San Diego from the Los Coronados Islands on the south to La Jolla on the north.

The following table, compiled from the field records, shows something of the amount and distribution of the summer's work:

Locality.	Stations.	Hauls.			Tem.	Soundings.	Salinity
		Dredge or Plankton.					
		Trawl.	Surface.	Deep.			
San Pedro	27	40	66	3			
Catalina Island	17	31		4			
San Diego	41	88		4			23—
Total.	85	159	66	11	194+	170+	19

EQUIPMENT.

Vessel.—The new gasoline launch *Elsie*, forty feet in length over all, with a 17-horse-power engine, was hired for three months, from May 15 to August 15. The boat proved to be excellently adapted for the purpose, although not built for such service. Contrary to the usual practice in the construction of boats of this type, her entire middle and after portions are without cabin, and are consequently available for working space. The hoisting gear was placed in the middle. The after-deck was supplemented by a temporary structure, extending between it and the hoisting winch, to be used for receiving and sorting the contents of the dredge.

One of the most serious obstacles in the way of successful dredging and trawling with a vessel propelled by a gasoline engine is always found in reducing the speed of the boat sufficiently to keep the trawl on the bottom during the towing without unduly weighting the apparatus. The problem was solved in this instance by using a battery instead of the engine's dynamo for exploding the gasoline, and by casting out a sea-anchor under some conditions.

HOISTING GEAR AND COLLECTING APPARATUS.

A hand winch was used for handling the collecting apparatus. With this the strength of four men was sufficient for accomplishing the dredging aims of the expedition, although it was found that a depth of a hundred fathoms for the dredge, and three hundred fathoms for the deep plankton net, reached about the limits of practicability. Manila rope nine sixteenths of an inch in diameter was used for all the dredging and deep plankton work.

HYDROGRAPHIC APPARATUS.

The sounding apparatus consisted of the ordinary leads of twelve and twenty pounds weight, galvanized steel wire, No. 10, of the American Steel and Wire Company's grading, and a hand reel, used both for paying out and for reeling in, and for registering the depth. The Miller-Casella thermometer was used for all temperatures below the surface. Surface and atmosphere temperatures were mostly taken by an ordinary chemical instrument. The bucket for taking subsurface samples of water consists of a brass tube 47 mm. in diameter and 500 mm. in length. The closed lower end is provided with a valve opening inward. The upper end is open during the descent of the instrument, so that the water may pass freely through it. The bucket is attached to the sounding-line above the lead and thermometer, the line being passed through the length of the tube and the middle of its bottom. The instrument having been sent down to the depth from which the water sample is desired, is then closed by a messenger sent down on the line. The apparatus was not satisfactory, but was the best obtainable under the circumstances. No observations on the composition of the water were attempted, beyond the determination of its specific gravity. For this work the most sensitive hydrometer available was one with a range of scale 1.000 to 1.040. This not being sufficiently accurate for wholly reliable results, the main dependence was placed upon weighing the water samples.

It was, of course, impossible to use either salinometer or scales on board the launch, but precautions were taken not to allow the water samples to remain long in the bottles before being tested. Temperature corrections were made in all cases. The salinity observations are the least satisfactory, probably, of any of the work seriously attempted. The difficulties of this phase of hydrogaphic investigation are well known to all experienced in it; and greater refinement of both appliances and methods than the funds at our disposal this summer would permit would be necessary to make it satisfactory.

THE LOCATION OF STATIONS.

An essential feature in such a survey as is here contemplated must be a study of the change in the life of particular localities with the passage of time. The displacement of species and groups of species by others through physical or biological influences; their increase in numbers of individuals; their migrations, etc., are among the most important, but least understood, questions of marine biology. Data for sound generalizations on these questions must meet two general conditions: First, they must be gathered at fairly frequent intervals throughout an entire year at least; second, they must be gathered from the same identical spot, so far as this is possible. The locating and picking up of stations becomes, consequently, a matter of prime importance. After consultation with several experienced hydrographers, particularly to be mentioned being Professor George Davidson, Mr. Otto Von Goldern, U. S. Engineer Corps, and Lieut. Commander G. C. Calkins, U. S. N., it seemed best to depend upon the sextant for this work. It was believed that greater accuracy could be secured than with the compass, and that it would be more practicable and less expensive than the range-pole method. In the hands of Professor Raymond for the first portion of the season, and of Professor Kofoid for the second portion, it proved as satisfactory as any method could, I am convinced. The difficulties in the way of making the haul with the dredge or trawl over precisely the desired course were found to be wholly independent of the method of locating the station. Of these, the drift due to wind and current, which frequently renders it impossible to get the dredge to the bottom at precisely the point after this has been located, is the most serious. It was found practicable to approach within fifty yards of a desired point two or three miles off shore at the first trial; and by maneuvering once or twice, giving careful heed to the currents and wind, the point may be reached almost exactly. This requires, of course, considerable practice with the sextant, and skill in handling the engine and wheel of the boat.

The procedure consists, as is well known, in locating two angles from three points on shore that are shown on the Coast and Geodetic Survey charts and are as near the level of the water as possible, and not near the circumference of a circle the center of which is the observer; and then of plotting the station on the chart by the use of a tracing-paper protractor.

This method could not be used, of course, at any considerable distance from land, nor on a coast devoid of prominent headlands or other permanent conspicuous objects, nor where fogs are prevalent. Within the geographical and bathymetric limits, however, set for the summer's operations, none of these restrictions applied. At no point is the one-hundred-fathom curve more than ten miles off shore; and in only a few places is it more than five or six miles off.

LABORATORY.

Two small wooden buildings at East San Pedro were rented for the summer and rebuilt to adapt them to the purposes of a laboratory. These buildings were situated on the breakwater near the pier belonging to the Salt Lake, Los Angeles, and Terminal R. R. This location was selected because of its convenience on the one hand to the inner harbor, and on the other to the open sea. On the harbor side a landing for the launch was at hand within a few yards of the laboratory, and the freight and express offices were equally near by. On the ocean side sea water entirely unpolluted by refuse from shore or shipping came to the very door of the laboratory.

Of the two buildings, one, an old bathhouse, was fitted with seven small private rooms for the use of the investigators, though one of these had to be set aside for the library.

The second building, a larger one, was used for the summer-school classes, for storage and for some of the investigators who could not be provided with private rooms. Accommodation was supplied for a class of fifteen students.

The laboratory equipment, consisting of the usual sort for seaside work, as also the library, were sent from the University at Berkeley.

INVESTIGATIONS PROSECUTED AT THE STATION.

'The Classification and Structure of Diatoms': Mr. Wm. Constantin Adler-Mereschkowsky.

'The *Peridinium* Visitation that took place on the Southern Coast during the Summer': Mr. H. B. Torrey.

'Speciographic and Ecological Studies on the Actinians of the Region': Mr. H. B. Torrey.

'The Systematic Position and Variation of various species of Echinoderms': Miss G. R. Crocker.

'The Variation and Autotomy of the star-fish *Phataria unifascialis*': Miss Sarah P. Monks.

'The Nemerteans of the Region': DR. W. R. COE.

'The Opisthobranch Molluscs of the Region': PROFESSOR T. D. A. COCKERELL.

'Classification and Distribution of the gastropod and bivalve Mollusca': PROFESSOR J. W. RAYMOND and MRS. IDA OLDROYD.

'Speciographic and Anatomical Studies on Bryozoa': MISS ALICE ROBERTSON.

'The decapod and amphipod Crustacea': DR. S. J. HOLMES.

'The Enteropneusta, Studies on Anatomy and Habits': PROFESSOR WM. E. RITTER.

'The Ascidians of the Region': PROFESSOR WM. E. RITTER.

'Experimental Studies on the Fertilization of *Ciona*': DR. F. W. BANCROFT and MISS ETHELTYN FOOTE.

'Experimental Studies on the Heart Action of *Ciona*': DR. F. W. BANCROFT and MR. C. O. ESTERLY.

'Selection in the Mortality of *Hippa* due to the Peridinium Visitation': DR. F. W. BANCROFT.

SOME OF THE SCIENTIFIC RESULTS OF THE SUMMER'S WORK.

Hydrographic.—On this side it is not felt that the data collected are sufficient in quantity to warrant any statement about them in a preliminary report, beyond the mere presentation given above, of what was done.

Geological-Biological.—The observations made corroborating the view that Santa Catalina Island has recently been undergoing subsidence have already been published in this journal, October 11, 1901, p. 575, and need not be repeated.

Special interest, from the biological side, was attached to the exploration of the peculiar 'submarine valleys' that are so characteristic a feature of the coast of California, Lower California and Mexico. As, however, a complete study of them will lead into deeper water (at their seaward ends into at least eight hundred fathoms*) than we were this year fitted to penetrate, and will go beyond the limits to which detailed soundings have been carried by the Coast and Geodetic Survey, our observations are yet too few and fragmentary to warrant any general conclusions. Two points may, however, be mentioned as having been brought out by our work. *First,* that the bottom deposits of some, at least, of the valleys, for example that at Redondo, even at the distance of several miles from shore, are of a character to prove that close inshore material is carried into them in large quantities. Shore-worn shells of strictly littoral, and even fresh-water species; fragments of drift-wood; kelp hold-fasts, of which none grow in the immediate vicinity, etc., were taken in abundance by the dredge.† *Second,* various species of deep-water fishes, crustaceans and molluscs were taken much nearer shore in these valleys than elsewhere.

The first mentioned observation suggests, though of course does not prove, that the valleys are natural channels through which currents flow, at times at least, *from the shore out to deeper water.*

*The U. S. S. *Albatross,* surveying the Monterey submerged valley with a view to its possible termination for a transpacific cable, found 868 fathoms sixteen and one half miles from shore.

† Professor Davidson gives something on the character of the bottom in most of the valleys, as determined, presumably, by the soundings. This method cannot be relied upon for the detection of such deposits as are here described. It is a suggestive fact, however, that the author mentions, in connection with the Cape Mendocino submerged valley, that "the valley itself has green mud, and yet in two places at depths of three hundred and twenty fathoms broken shells were brought up with gravel." ('The Submerged Valleys of the Coast of California, U. S. A., and of Lower California and Mexico,' *Proc. Calif. Acad. Sci.,* 3d ser., Geol., Vol. I., No. 2, 1897.)

It cannot be doubted that future study will prove these valleys to play an interesting part in the local distribution of marine life, particularly in the bathymetric distribution. Whether currents ever flow through them *from the deeper waters toward land* or not, certain it is that the temperature and pressure conditions within them are the same as for corresponding depths elsewhere; they must, consequently, form natural roads whereby deeper water species may reach nearer shore than they otherwise would.

BIOLOGICAL.

Diatomes.—Mr. Adler-Mereschkowsky came to California for the purpose of studying the diatomes of the West American coast. He has already published a list of California species. The summer's work at the San Pedro laboratory resulted, so far as the studies have yet gone, in identifying fifty known species and ten new ones, with one new genus.

But the most fruitful part of Mr. Adler-Mereschkowsky's work was that on the endochrome of these organisms. His observations here have led him to conclusions widely different from the prevailing views concerning these bodies.

Protozoa.—There occurred during the summer on the coast of southern California what might be called a *Peridinium* epidemic, for the people even, who resort in large numbers to many sea-shore points during the summer months, did not escape the noxious effects of the visitation.

No similar occurrence of this organism on the Pacific coast of North America is recorded so far as I am aware. Indeed, inquiry among many old fishermen, and longshore seamen, who have been familiar with the region for many years, elicited the affirmation, in every instance, that such a thing had never before taken place within the period of their acquaintance with the coast. As full a study of the phenomenon was made as the facilities at our command would permit, and the results as brought together by Mr. H. B. Torrey are now with the *American Naturalist* for publication. A summary only of these results is, consequently, given here:

1. The duration of the visitation of the organism in sufficient quantity to appreciably color the water was from about July 7 to September 1, 1901.

2. The geographical extent of the phenomenon was from Santa Barbara at the north to San Diego at the south, at least (it may have extended farther south, but we have no reports from more southerly points); and in general from the shore out from four to six miles.

3. Nowhere were the organisms distributed uniformly over considerable areas, but were confined more or less completely to bands or strips varying from a few to many meters in width. They extended to the bottom at a depth of six fathoms at least; but the appliances for determining the bathymetric range were not sufficiently accurate to produce wholly reliable results.

4. The color imparted to the water varied from a light brown, where the organisms were in moderate numbers, to a vermilion, where they were in greatest abundance. The red coloration was due to material of this color contained in the nucleus. At night the phosphorescent display, at the slightest agitation of the water, was truly wonderful.

5. The presence of the organisms in such enormous numbers disturbed the biological equilibrium to a marked degree through the whole area. Several species of fishes, crustaceans, holothurians, star-fishes, and molluscs, in particular, suffered a severe mortality, and showed various unmistakable evidences of discomfiture.

6. The injurious effects were apparently due entirely to crowding and the contamination of the water. The odor at times on

the lee shore, and for a considerable distance inland, was very offensive. This was due to the *Peridinium* itself, and not to animals killed by it. In character it was a modification of the ordinary odor of decomposing organic matter, and was mostly due to the dead organisms cast up on the shore.

7. A considerable list of other species of chlorophyl-bearing dinoflagellates were present in the water mingled with the *Peridinium,* and these, particularly several species of *Ceratium,* largely increased in numbers simultaneously with the increase of *Peridinium,* though to a comparatively slight extent.

8. The only pelagic organism that seemed to take advantage of the great abundance of *Peridinium,* as a food supply, was *Noctiluca,* which towards the end of the visitation became abundant, and fed upon the *Peridinium* in large numbers.

9. But a single species constituted almost the entire mass, this apparently belonging to the genus *Gonyaulax* Diesig.

10. It was impossible to correlate the enormous multiplication of the organism with any physical or chemical condition of the water. The cause of such a phenomenon remains for future investigation.

Cœlenterata.—Siphonophores and ctenophores were taken in far greater abundance, as to both species and individuals, in the plankton this year than we have ever before seen in the waters of our western coast. Worthy of mention, also, is the fact that *Valella,* which at rare intervals appears in enormous abundance on the coast, was found to be throwing off medusa buds in great numbers during May and June.

Whether the richness in pelagic metazoan life, seen not only in the groups here mentioned, but also in the Pteropoda, Heteropoda, *Sagitta, Salpa, Doliolum,* etc., may have been correlated with the conditions which resulted in the enormous development of *Peridinium,* it is impossible to say owing to the lack of data from previous observations.

Perhaps the most interesting observations on the Cœlenterata were those made by Mr. Torrey on the longitudinal fission, *from the base oralward,* of a species of *Sagartia.*

Echinodermata.—Of the several interesting questions in connection with the speciography and ecology of the echinoderms, which received attention, mention may be made of two. The representatives of this branch of the animal kingdom, the most common and generally distributed over the area in which work was carried on, are an *Astropecton* (*A. erinaceus* Gray?) and a *Toxopneustes* (*T. pileolus* Ag.?). Few hauls were made anywhere that did not secure specimens of these species, the *Toxopneustes* being particularly abundant. A single haul of the dredge on Station XIII. off Point Vincente in thirty-five fathoms brought up about *twelve thousand specimens,* by a careful estimate, *and little else!* Now the type of *Toxopneustes pileolus* is a littoral animal occurring everywhere on rocky shores. The forms dredged are of a different style. They are somewhat flatter, the spines are more slender; and the color is lighter; yet the two grade into each other. It is almost certain that we have here the differentiation of two species in progress and nearly complete, bathymetric range being the chief differentiating factor.

A large quantity of material and considerable data for the further study of this point were gathered. In a somewhat similar way *Astropecton* is a distinctly bifurcate species. Indeed, one of the forms has sometimes been considered as a *Psilaster.* Their intergradation is, however, from our summer's observations proved to be complete. Longer spines with intermarginal plates, purplish and bluish color and larger-sized individuals, are the characters usually distinctive of *A. erinaceus.* But these all fail to furnish differential marks for many specimens.

With these two forms, contrary to what we find in *Toxopneustes, bathymetric range appears to play no part,* as they occur together everywhere in from eight to ten fathoms, to the greatest depths reached in our work. We have thus far been unable to correlate these two varieties with any environmental peculiarities whatever. The general distribution of these two species, as contrasted with the restricted distribution of some other species of both Echinoids and Asteroids in this locality, is noteworthy and is all the more interesting when the variability—as contrasted with the lack of variability in other species localized in their distribution—is regarded. *Mediaster æqualis* Verrill, for example, may be cited as a species of great rigidity in type. The individuals of this species all have the appearance of having been cut out by the same die, so alike are they in form; and having been dipped in the same paint-box, so similar are they in color. This species was taken at only two or three stations, and in any abundance at only one. Such facts as these strongly impress one who comes face to face with them with the scantiness of our knowledge of the deeper meaning of the relation of organisms to their environment.

Miss Monk's studies on *Phataria*, a starfish remarkable even among its close allies within the family Linckiidæ, for the variability in the number of its rays, and the readiness with which it parts with them and then regenerates them, led to the following results:

1. The observations proved conclusively that the casting off of the rays is, in most cases at least, *not accidental, but a true self-amputation.*

2. As the breakage usually occurs at some distance from the disk, and as the 'comet' stars are found abundant in nature, it appears as though the autotomy is for the purpose of asexual reproduction, and hence that the severed arm to which no part of the disk adheres has the power of reproducing the entire animal. But absolute certainty on this point is still to be reached.

A species of *Antedon* closely related to, if not identical with, *A. rosacea* was taken off San Diego in about one hundred fathoms. So far as I am aware, this is the first record of the occurrence of any species of this genus on the Pacific coast north of Panama.

Bryozoa.—Under the name of *Ascorhiza Californica,* Dr. Walter Fewkes described a new genus and species of Bryozoan dredged by him in Santa Barbara channel in 1886. The colony consisted of a well-defined capitulum, to which the polypides are restricted, and a long, slender, flexible stem. From the general resemblance of the stem to that of *Urnatella*, the author surmised the species to be related to the Endoprocta. In the capitulum, however, he recognized some resemblance to *Alcyonidium.* He, consequently, suggested that the form might stand intermediate between the Endoprocta and the Ectoprocta. As he did not, however, make out much about the polypides, he was unable to support the suggestion with much evidence.

Several specimens of this unique species were dredged during the summer, and from these Miss Alice Robertson has been able to establish definitely that its affinities are undoubtedly with *Alcyonidium,* and that its resemblances to *Urnatella* are wholly superficial. It is, nevertheless, a very interesting form, especially in the nature of the stem. Miss Robertson will shortly publish a paper on this and one or two other species of *Alcyonidium* of the Pacific coast.

A noteworthy fact in connection with the

Bryozoa of the regions worked in during the summer is the great abundance of the Endoproct *Ascopodaria macropes.* At no other point on our shores have we found this or any other Endoproct very plentiful. At San Pedro, however, nearly every rock one turns over presents a continuous moving field of this or a closely related species.

Mollusca.—No group of marine invertebrates of the Pacific coast of North America has been so extensively studied, systematically, as the shell-bearing mollusca. For this reason, then, if for no other, these animals are of special importance for studies on geographic and bathymetric distribution.

The expedition was fortunate in having for nearly the entire summer two such enthusiastic and well-informed conchologists as Professor Raymond and Mrs. Oldroyd in its membership; and a vast amount of material was secured, the detailed examination of which is, of course, still far from complete. Some idea of the wealth of the collections in the group may be gained from the statement that in the San Pedro and Santa Catalina Island areas alone two hundred and thirty species, exclusive of the Polyplacophora and Pteropoda, have been identified, and it is certain that the number will be largely increased by more detailed study. A few species are almost certainly new to science, though just how many it is not yet possible to say.

The total number of species of mollusca of the Pacific coast of Canada contained in the list published by Rev. G. W. Taylor in 1897 is two hundred and seventy-nine. The total number in the list of species of Los Angeles County, now in course of preparation and nearly complete, by Mrs. Oldroyd, is something over five hundred.

The familiar, though nevertheless striking, general rule of the occurrence in comparatively deep water off shore of species that are strictly littoral to the northward, receives many illustrations in this group. A good example is furnished by *Priene oregonensis* Redfield, which occurs in a few fathoms at Sitka, Alaska, and was taken this summer in about one hundred fathoms off San Diego. *Cryptochiton stelleri,* also found in this locality for the first time this year, I believe, is another example of the same sort.

Professor Raymond has elsewhere* expressed the view that Point Conception marks a dividing line between molluscan faunæ to the north and south of it that are quite distinct; and Dall† affirms that Point Conception is the northern limit of the Panamic fauna.

The results of the summer's work, so far as they can yet be seen, confirm these views. To harmonize the apparent fact of this faunal delimitation with the view that the Davidson inshore current flows out of the Santa Barbara channel around Point Conception and then on northward, is only one of the many problems presenting themselves for solution on our coast.

Worthy of note is the discovery made by Mrs. Burton Williamson during the summer while at work at the laboratory, that at least two species of *Pecten* occurring on the southern coast, viz., *P. equisulcatus* and *P. diegensis* are hermaphroditic. A species of gymnosmatous pteropod related to *Pneumodermon pacificum* Dall, though probably a different species, was taken with the deep plankton net in San Pedro channel in considerable numbers. No species of this genus, excepting *pacificum,* has been reported hitherto from the California coast, so far as I have been able to ascertain.

Many of the specimens of a species of

*'The California Species of the genus *Nuttalina,*' *Nautilus,* Vol. VII., 1894, p. 133.

†'Synopsis of the Family Tellinidæ and of the North American Species,' *Proc. U. S. Nat. Mus.,* Vol. XXIII., 1900.

Carinaria, apparently new, taken in considerable abundance off San Pedro, were found to be headless, though still alive and well, thus presenting a condition that has been observed by a number of naturalists in *Firola*. This decapitate state was so common, and so uniform in character—*i. e.*, as to the size of the portion lost and the character of the wound—that it can hardly be supposed to have been due to mere accident. The meaning of this case is as difficult to understand as is that of the self-amputation of the posterior third of *Prophysaon* which has been noted by several observers, and which I have myself seen.

Of the opisthobranch and nudibranch mollusca, about twenty species were recognized in the San Pedro district by Professor Cockerell. Of these, five at least are almost certainly new.

Crustacea.—Of the seventy or more species of decapod crustacea taken at San Pedro during the summer (the San Diego collections have not yet been worked over), five, according to Dr. Holmes' preliminary examinations, are probably new to science, the presumably new forms all coming from deep waters. Among them may be mentioned as of special interest a Pagurid inhabiting the tube of the Annelid Pectinaria.

A noteworthy extension of geographic range in this group is that of three species of *Pandalus*, viz., *P. Danæ* St., *P. pubescentulus* Dana, and *P. franciscorum* Kingsley. None of these were before known to occur south of San Francisco and *pubescentulus* was not known farther south than the coast of Oregon.

The beautiful *Navanax ineremis* Cooper, which is not uncommon in San Pedro harbor, is the residence of an interesting copepod which has the curious habit of using the slime of its host's external surface not merely for clinging so closely as to make its removal quite difficult, but also as a medium in which to move about with great freedom and rapidity. Professor Cockerell, in particular, gave considerable attention to this curious case of commensalism.

The summer's work brought to light one new Enteropneust, making thus three species representing as many genera, from the San Pedro district. *Ptychodera occidentalis* Ritter MS. and *Dolichoglossus pusillus* Ritter MS. occur together in San Pedro inner harbor, while the one now added belonging, apparently, to the restricted genus *Balanoglossus*, was taken by the dredge in from seventeen to thirty fathoms off Newport, California.

The new species is related to *Balanoglossus canadensis*. Unfortunately, we were able to get only three specimens.

It is my intention to include the description of this species in my forthcoming monograph of the Enteropneusta of the Pacific coast of North America, now nearly ready for publication, and to appear in the scientific results of the Harriman Alaska Expedition.

About thirty species of simple and compound Ascidians were collected during the summer, the larger proportion of them being taken by the dredge only. At least four of these have not been taken before on the Pacific coast, and are almost certainly new to science. Even the deepest dredging failed to bring to light much of anything in common between the Ascidian fauna of this region and that of the Pacific coast north of Puget Sound. At the present time I identify two species, viz., *Amaroucium californicum* and *Distaplia occidentalis*, and possibly a third, *Styela montereyensis*, as ranging from western Alaska to southern California.

The work of Dr. Bancroft and Mr. Esterly on the heart-beat of *Ciona*, while still incomplete, arrived at the follow definite conclusions:

(1) The results confirm those of Schultze that isolated pieces from the center of the heart can contract in sea water. (2) They have established the new facts, (*a*) that in the intact animal the heart may sometimes beat *from the center towards both ends;* also, (*b*) that when the heart is tied near the center, the *isolated pieces may sometimes beat from the center towards the ends;* and (*c*) in *such pieces* there may even be a *regular alteration in the direction of the heart-beat.* These last results will probably necessitate a complete change in our conception of the character of the Ascidian heart-beat.

This is a proper place to record the occurrence of *Branchiostoma Californiense* at San Pedro, hitherto not known farther north than San Diego. About a dozen specimens were dredged during the summer, some in the inner harbor, and others outside but near its mouth.

It may also be noted here that the Point Loma blind fish, *Typhlogobius Californiensis,* hitherto not reported north of San Diego, was found at San Pedro. At White's Point it was found in holes in the soft rock and under stones; while during the *Peridinium* visitation a considerable number of specimens were cast ashore, some alive and others dead, along the breakwater at San Pedro.

WM. E. RITTER.

UNIVERSITY OF CALIFORNIA,
BERKELEY, October 29, 1901.

SCIENTIFIC BOOKS.

A Treatise on Hydraulics. By HENRY T. BOVEY, M. Inst. C.E., LL.D., F.R.S.C. Second edition, rewritten. New York, John Wiley and Sons. 1901. Pp. xviii + 583. Figs. 330. Price, $5.00.

The second edition of Dr. Bovey's well-known text-book is practically a new work, having been largely rewritten, rearranged and nearly doubled in extent; forming a very important and valuable addition to the literature of engineering education. It contains 583 pages and 330 figures, as against 337 and 196, respectively, in the first edition; embodying also some improvements in mechanical execution, such as the substitution of clear-cut line engravings for the few (but hazy) half-tones illustrating certain water-meters in the first edition, and the use of bold-faced type for important formulæ. Being printed on thinner paper the present volume possesses no more weight or bulk than the earlier book.

As in the earlier edition, the statements of many numerical examples, with their answers, are placed at the end of each chapter, and these have been greatly increased in number (*e. g.,* at the end of Chapter I. we find 106 examples as against 76 in the first edition); but a new and special feature in this respect consists in the insertion, in the body of the text in connection with each topic, of numerical examples fully worked out in all their details. This added feature will be heartily welcomed by engineering students possessing only average mathematical ability, and hence needing careful guidance in the principles of correct numerical substitution.

Among additions to the subject-matter the following are prominent:

A description of the elaborate apparatus in the Hydraulic Laboratory of McGill University, for experimentation with jets of water (as to coefficients of efflux, form of jets and impact of jets on vanes and cups of various shapes); with methods of use and results obtained.

An illustrated abstract (ten pages of fine print) of Bazin's papers in the *Annales des Ponts et Chaussées* on experiments with weirs; including the phenomena of depressed, drowned and adhering nappes.

In connection with flow in pipes, the formulæ of Darcy, Hagen, Thrupp, Reynolds, Lévy, Vallot, Manning, Tutton, Flamant, Foss and Lampe.

Many of the results obtained by Mr. C. H. Tutton in 1896 in his careful and extended collation, and logarithmic plotting, of the elements of some 1,000 recorded experiments on the flow of water in pipes; with diagrams and formulæ.

For uniform flow in open channels, the formulæ of St. Venant, Bazin, Manning, Tutton, Humphreys and Abbot, and Gauckler; and extensive tables of the coefficients to be employed with the formulæ of Bazin, Ganguillet and Kutter and Manning.

A practically new and well-illustrated chapter (Chapter IV., of 25 pages and 22 figures), on hydraulic rams, presses, accumulators and water-pressure engines.

Some of the results of Freeman's experiments with nozzles, jets and hose for fire-engines.

Considerable extra matter in the theoretical treatment of vertical water-wheels and turbines.

A new chapter (of 30 pages and 22 figures) devoted exclusively to centrifugal pumps; giving much practical detail as well as theoretical treatment.

References (on pp. 168 and 206) to the recent experiments made at Detroit by Prof. G. S. Williams and others on the flow of water in pipes; as regards the loss of head due to curves in pipes from 12 to 30 inches in diameter, and the distribution of velocity in the cross-section. (See *Proc. Am. Soc. Civ. Engineers* for May, 1901, and later discussion.)

It is seen that much of the above added matter has to do with the practical and experimental side of the subject; and in this connection it is perhaps to be regretted, from a practical standpoint, that the author had not omitted a large part of the theoretical treatment of unimportant and nearly obsolete forms of vertical water-wheels, substituting therefor some account of recent modern turbines and their appurtenances such as the wheels at Niagara Falls and the prominent American makes known as 'Victor,' 'New American,' 'Hercules,' 'McCormick,' etc.; with a chapter giving methods and results of tests of efficiency.

Criticism and comment on a few incidental points may perhaps be permitted. 'American' readers of the book may need to be reminded that the gallon employed in the numerical examples (gallon of water) is the Imperial gallon of 271 cubic inches used in England and weighing 10 pounds. The weight of the United States gallon (8.32 lbs.) is not mentioned in the work, although its volume (231 cubic inches) is given in the preliminary table of 'Useful Constants.'

As to the compressibility of water (see p. 5) and corresponding modulus of elasticity of volume, the author might have mentioned the experiments described by Mr. Stillman on p. 236 of *Engineering News* of October 4, 1900. In these water was subjected to a pressure of 65,000 pounds per square inch, with a resulting reduction of volume of 10 per cent.

In the treatment of problems involving the steady flow of water in branching pipes the reader might have been reminded of the great saving in time and trouble that can be accomplished by the use of diagrams of friction-heads in pipes, such as are given in Collignon's 'Hydraulique' and in Coffin's 'Graphical Solution of Hydraulic Problems,' and incidentally in engineering periodicals. (On p. 415 of the *Engineering Record* for November 3, 1900, Mr. J. H. Gregory presents such a diagram; which, having a logarithmic basis, covers a wide range of values both of diameter of pipe and friction-heads.) Although many results of experiments with pipes are stated in graphic form (Tutton) in the work before us, the diagrams are not arranged with a view to giving aid in the solution of problems. Since only the logarithms, and not the quantities themselves, are figured along the edges of these diagrams, the latter are not available for ready use.

There would seem to be some inconsistency in presenting the numerical example of p. 161 as apparently an illustration of the theory given in article 12 ('Pressure Due to Shock') of p. 160. In article 12 the closing of the stop-gate is instantaneous, and the kinetic energy of the moving water is absorbed by the elastic compression of the water itself (the pipe being supposed fixed and its possible distension neglected). In the numerical example, however, the stop-gate is gradually closed and is supposed to be handled in such a way as to make the retardation of the cylinder of water *uniform;* and as the kinetic energy of the great mass of the water is gradually given up a nearly equal amount of kinetic energy is generated in the smaller mass passing (with high velocity) through the narrowing sectional area under the edge of the gate. Here the compression of the water is not considered, the pressure being small; as is shown by the fact that neither the modulus of elasticity (of volume) nor the velocity of sound enters the equation employed. It would have been well to remind the student at this point that in the gradual closing of a stop-gate, if the motion of the gate is uniform the rate of retardation of the water can not be uniform, and that the pressure induced just behind the gate is consequently variable and reaches a maximum value which may be many times as great as the average pressure (which average is equal to the pressure produced when the gate is so managed as to make the retardation uniform, the whole time of closing remaining unchanged).

As to the discussion of the impact of a jet upon a flat plate or vane (p. 378), one cannot help thinking that it would have been preferable to substitute for this rather lengthy and involved treatment (where the reader must be uncertain whether the plate is furnished with borders parallel to the paper or not) the simple and direct analysis given by Rankine in Case V. of § 144 of his 'Steam Engine and Other Prime Movers' (also given by Cotterill).

On page 500, in the theory of the turbine, the term 'velocity of flow' is used in a sense entirely different from that specially defined on page 498; and on the same page (500) obscurity of language results from the apparent statement that impulse equals momentum (instead of change of momentum).

The author is evidently (p. 96) of the same opinion as Collignon (see 'Hydraulique,' p. 146) when he designates as 'gratuitous' the assumption that in the case of a flat-topped weir the flow adjusts itself to such a depth on the weir as to bring about a maximum discharge. Several authors have noted that experiment gives results not very wide of this relation. Unwin (p. 472, article 'Hydromechanics, Encyclop. Brit.) is rather non-committal on this point, though giving the same analysis; whereas Mr. J. P. Frizell (see *Engineering News* of September 29, 1892) is plainly of the opinion that the flow should theoretically adjust itself to a maximum discharge.

I. P. CHURCH.

Dragons of the Air, an Account of Extinct Flying Reptiles. By H. G. SEELEY, Professor of Geology in King's College, London. London, Methuen & Co.

When so accomplished a student of extinct life as is Professor Seeley writes in so pleasing a way as he has of a group of animals to which he has devoted many years of study, the results can only be happy. Divested so far as is possible of technicalities, accurate in statement, lucid in presentation, and enriched by patiently gathered facts from many sources, his present work upon the 'Dragons of the Air' summarizes for the paleontologist, as well as for the general reader, about all that is known of those strange fossil reptiles called pterodactyls or ornithosaurs. The book contains a discussion of reptilian characters, the range and distribution of pterodactyls, a review of the known forms, and a thorough comparison of them with other vertebrated animals, part by part, a history of their development, inferences as to their habits, and conclusions as to their place in the animal kingdom.

It is illustrated by many figures and plates of the bones or skeletons of pterodactyls and allied animals, and by many restorations of the creatures as the author and others have conceived them. In a few words, the work, while popularized, is a critical review of this extinct order of reptiles from many sides, interesting because of the strangeness of the animals and valuable to the student of vertebrate morphology, as well as to the geologist.

However, with the fullest respect for the author's anatomical erudition and admitting the force of his reasoning in many cases, the present writer can not always agree with his conclusions. To review them all would be out of place here; the curious reader may expect a wider discussion elsewhere. Many of the bird-like or mammal-like characters which he sees in the pterodactyl, Professor

Seeley would ascribe to ancestral, fundamental impressions, and not to adaptation. The present writer believes that the elongation of the wing finger, the progressive weakening of the middle fingers and the peculiar shape of the first finger are all purely adaptive, together with the shape of the humerus, the peculiar form of the sternum, the anchylosis of bones, the shortening of tail and concomitant increase in length of the sacrum, the diminution and loss of the fibula, the loss of teeth, retreat of the nostrils, etc. The bone in the lizard commonly called the squamosal extends to, or nearly to, the brain surface in the mosasaurs. If the determination of the bone be right, this character loses its value as an avian index in the pterodactyls; if wrong, there is the same possibility in the pterodactyls. *Dimorphodon* had the fifth toe peculiarly modified for the sustentation of the patagial membrane. What good reason then has Professor Seeley for supposing that this specialization was lost in later forms; that the membrane was restricted to the sides of the body only? The rudimentary fifth toe in *Ornithostoma* was divergent. What use had it unless that of *Dimorphodon?* In bats the membrane extends to the ankle and over the tail. It is reasonable to suppose that such were its relations in all the pterodactyls, the later as well as the earlier.

Especially does the writer disagree with Professor Seeley in his opinion that the quadrupedal position of the body in ambulation was a normal one. He doubts very much whether the peculiar articulation of the humerus would permit such a position of the bones in some of the pterodactyls. And what use were the loosely attached middle fingers of some pterodactyls as ambulatory organs? In a specimen of *Ornithostoma* recently acquired by the University of Kansas, the small fingers are in position, from which it is evident that they could not have been brought to the surface of the ground in a state of pronation. Nor does it seem reasonable that the animals walked upon the knuckles of the fifth fingers. In those animals in which the body is carried more or less erect, as in birds and dinosaurs, there occurs elongation of both sacrum and ilium. In the early pterodactyls there were three or four sacral vertebræ; in *Nyctodactylus*, one of the latest, there were six true sacral vertebræ and one coossified lumbar. It thus would seem that some or all pterodactyls walked erect when upon the ground, with the knees probably much flexed. The pelvis of *Nyctodactylus*, with an expanse of outstretched wings of fully eight feet was less than seven eighths of an inch in diameter at the brim, and not three fourths of an inch at the outlet. The heads of the femora in the largest species measuring twenty feet in expanse were less than two and a half inches apart. If the legs were knock-kneed, as seems probable, both of the feet in such animals would have rested upon a space smaller than one's hand. In the posture I have indicated, with the body erect, the wing metacarpal bones would have rested upon the ground at the sides.

The eggs of *Nyctodactylus* could not have been three fourths of an inch in diameter, and of *Ornithostoma* not over two inches. How big would the young have been recently hatched from such eggs? Were they cared for by their parents after birth? Did the pterodactyls build nests?

S. W. Williston.

PAPERS ON ENGINEERING.

The *Proceedings* of the Royal Society, just issued (Vol. XVI., Part II., Lond., Nov., 1901), contain a number of papers of peculiar interest in the field of applied science and engineering.

The opening article is by Lord Rayleigh, on 'Flight.' In this paper it is stated that the main problem in flight is that of the aeroplane, as in the case of the kite. But the kite is anchored and at rest relatively to the earth; while the aeronaut, the aviator, whether human or other, is adrift. No bird can maintain itself in motion in a uniform wind-current without active exertion, any more than in an atmosphere at rest. Soaring is thus evidently the outcome of utilization of internal movements of the atmosphere surrounding the bird. The albatross presumably takes advantage of such movements where strata move in proximity with differing motions. Langley has shown the possibility of taking advantage of the gustiness of the wind when soaring. Attention is called to the fact that the horizontal motion of an aeroplane greatly increases the pressure beneath it when falling, tending thus to sustain it effectively. On this fact depends the possibility of flight. The sustaining pressure is also reinforced by an important complementary suction above, with similar effect in supporting the falling mass. Artificial flight is a question of speed of horizontal motion; no man can raise himself from the ground by any mechanism operated by muscular power except with preliminary acceleration in the horizontal direction. Lord Rayleigh is inclined to agree with Sir Hiram Maxim that the problem of artificial flight is mainly one of time and money. It would presumably be mainly a military problem. He does not think it will prove a safe method of conveyance; but, as Maxim has remarked, we have not even yet succeeded in making war quite safe.

The Hon. Charles A. Parsons, in the second paper, discusses motive power and the steam turbine. He commences with a paraphrase of a page in the introductory section of Thurston's 'History of the Steam Engine,' in which the account of the steam turbine in Hero's 'Spiritalia' is presented, and goes on to say that an experiment made years ago in the production of a redesigned Hero engine enabled him to obtain twenty horse-power on a consumption of but forty pounds of steam per horse-power-hour, which is a very fair performance for engines of the simpler modern forms and of similar power. A later model illustrated his system of compounding, but without commensurate advantage. Branca's turbine of 1629, similar in principle and general construction to the impact waterwheel, had been reproduced successfully by Dr. La Val and is in extensive use in a form illustrating modern scientific construction. In 1884, Mr. Parsons began his work on his now familiar form of compound turbine, adopting the type of wheel known in hydraulics as the impact turbine. This proved practically successful, ultimately, and is now made in large numbers for electric 'plants.' It has been proved to be capable of as high economy as the reciprocating engines of the best modern constructors.

In 1894, the same plan was adopted for engines supplied to the *Turbinia*. The outcome was the redesigning of the screw-propeller and its method of application and the attainment of a higher speed than had ever before been recorded, 32¾ knots, 38 miles, an hour. The steam consumption was 14½ pounds per horse-power-hour, a result better than was usually obtained in similar craft with even triple-expansion engines and under similar conditions of steam supply. About 28 pounds of steam were vaporized per square foot of heating surface of boilers.

The *Viper* and the *Cobra* have been later built on the same general plan and the former became the record-breaking vessel for the world, attaining above forty miles an hour (37,118 knots, 43 miles) on the dimensions of the regular 30-knot torpedo boat destroyer, a length of 210 feet, a beam of 21 feet and with 350 tons displacement. Water-tube, safety-boilers were fitted and the engines were of the compound turbine type.

A design for a war-vessel is hypothetically proposed on this plan and Mr. Parsons considers it possible to build a ship of 420 feet length, 42 feet beam and 14 feet draught, having 2,800 tons displacement, which should develop *eighty thousand* horse-power and a speed of 44 knots (over 51 miles) an hour. This represents a concentration of power never before dreamed of by the engineer, far less attempted or approximated, although an American designer, Mr. Mosher, has rivalled the work of Parsons in smaller craft.

Papers by Professor Ewing on the 'Structure of Metals' and by Sig. Marconi on wireless telegraphy fall into the same general category of work in applied science, and those of Lord Kelvin, Professor Dewar and others are in the field of pure science and have special interest through their promise of later utilization. Sir Andrew Noble presents a remarkable and illuminating discussion of the modern explosives.

R. H. Thurston.

SCIENTIFIC JOURNALS AND ARTICLES.

The American Naturalist for December completes the thirty-fifth volume of this journal and contains the index for the year. The first article, by T. H. Morgan, is a discussion of 'Regeneration in the Egg, Embryo and Adult,' including the use of the term 'polarity' in organic beings and inorganic substances. The writer considers that the reorganization of living beings is an entirely different phenomenon from that of inorganic substances and one of the peculiar properties of what we call living matter. C. M. Child tells of 'The Habits and Natural History of Stichostemma,' a small fresh-water nemertean, and W. M. Wheeler contributes another of his important papers on the history of ants under the title of 'An Extraordinary Ant-Guest,' this being a phorid larva which fastens itself to the neck of the larvæ of a large ponerine ant and feeds with its host on food prepared by the workers. Herbert W. Rand gives an extended abstract of 'Friedenthal's Experimental Proof of Blood Relationship'; this is found in the fact that the blood serum of vertebrates undeniably related to one another has no injurious effect on the corpuscles of the different species, while it dissolves those of unrelated species. Similarly the transfusion of blood of species of one family is harmless, while blood transfusion among species of different species is harmful and may cause death. The number contains the 'Quarterly Record of Gifts, Appointments, Resignations and Deaths'; Mr. Carnegie still continues prominent in the founding of libraries.

The Popular Science Monthly for January commences the sixtieth volume, and opens with a description of 'The Minnesota Seaside Station' by Conway MacMillan. The station is on the Straits of Fuca in a favorable locality for varied research. The problems of 'Antarctic Exploration' are considered by J. W. Gregory who notes the objects of the four expeditions now on the sea, and Francis Galton discusses 'The Possible Improvement of the Human Breed under existing Conditions of Law and Sentiment,' concluding that this is not only desirable but possible. Charles V. Chapin writes of 'The End of the Filth Theory of Disease,' but adds that we should not become too closely wedded to the germ theory which has replaced it. 'Recent Eclipses of the Sun' are described by Solon I. Bailey, Edward S. Holden contributes a sketch of 'Friar Roger Bacon,' and W. H. Dall briefly reviews 'Lamarck, the Founder of Evolution,' a biography by A. S. Packard. The final article is on 'Comet's Tails, the Corona and Aurora Borealis' by John Cox, being a detailed review of Arrhenius' theory concerning them.

The Plant World for November contains the 'Rooting of Oxalis Leaves' by John L. Shelton, 'The Blooming of Twining Honeysuckles' by Byron D. Halsted, 'Fairy Rings' by E. M. Williams, 'You Will Have to Hurry' by Aven Nelson, and 'Field Notes of a Midsummer Tramp' by Charles C. Pitt. In 'The Families of Flowering Plants' Charles L. Pollard treats of the Order Parietales.

Popular Astronomy for January gives an account of observations on the recent Leonids, and an article by William H. Pickering upon the 'Period of Revolution of the Leonids.' R. G. Aitken, of the Lick Observatory, contributes an article entitled 'The Sources of Standard Time in the United States.' Shorter articles are 'An Asteroid Orbit of Great Eccentricity,' by E. C. Pickering; 'Eclipse Aid to Chronology,' by the Rev. Q. A. Wheat; 'The Period of Algol,' 'Transformation of the Differentials of Area and Volume,' by Asaph Hall; 'Motion in the Faint Nebula surrounding Nova Persei,' by C. D. Perrine, and a continuation of Dr. Wilson's 'Light Curve of the New Star in Perseus.'

Beginning with the new year *The Forester*, the official organ of the American Forestry Association and *National Irrigation*, the organ of the National Irrigation Association, will be combined and published under the name of *Forestry and Irrigation*.

Dr. George B. Shattuck, of the Johns Hopkins University, has lately been elected on the Board of Collaborators of the *Annales de Geographie* to take the place of Professor Wm. M.

Davis, of Harvard University, who has recently resigned.

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES, SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY.

THE Section met at the Chemists' Club on the evening of December 2. The following papers were presented:

Professor M. I. Pupin described an experimental investigation of 'Energy-Dissipation' in a weak magnetic field. The substance experimented upon was a toroid of square cross-section made up of iron plates .010 in. thick. The magnetizing force was supplied by a helix uniformly distributed over the core. The force applied was simple harmonic of 1,800 periods per second, and its amplitude could be varied from 0 to .1 C.G.S. unit. The inductance and resistance of the helix was determined in a Wheatstone bridge. The results obtained were compared with theory. According to the theory worked out by the author, inductance (L) and Foucault resistance (R) is given by the formulæ:

$$L = 2 s^2 \mu h \log \frac{b}{a}$$

$$R = \frac{4}{3\sigma} \pi^3 \mu d^2 f^2 L$$

where

s = number of turns in the helix.
μ = permeability of the iron.
σ = specific resistance of the iron in C.G.S. units.

f = frequency of the magnetizing force.
h = height of the core in cm.
d = thickness of the plates in cm.
a = internal diameter of the plates.
b = external diameter of the plates.

Up to about .05 C.G.S. units of the magnetizing force μ is constant and equal to about 80 in the samples of iron employed; there is no hysteresis, and the theory agrees very well with experiment. Beyond that limit both L and R increase; the increase of R is very rapid on account of hysteresis.

When the core is magnetized by a steady force and then after removal of this force L and R are measured it is found that they both change on account of the change of μ. Their values still agree with the theory within the above limits of magnetization. Hence weak magnetizations are not accompanied by hysteresis, both when the iron is neutral and also when it is already, even strongly, magnetized.

An increase of the permanent magnetization diminishes μ, and *vice versa*. The maximum change in μ thus obtained was 22 per cent.

Professor J. K. Rees presented some notes and lantern illustrations on observations of Leonids made at Bayport by C. A. Post and himself. The observations were made at Mr. Post's observatory during the nights from November 13 to 16 (both inclusive).

For the purpose of photographing meteor trails four cameras were fastened to the equatorial. Exposures for known times were made on identified parts of the sky. The results showed meteor trails on the plates taken between midnight and sunrise of November 15. Quite a remarkable meteor was shown on plates taken with the Willard and the Anthony lenses. This meteor appeared at 3.58 a. m. near the radiant point and exhibited a fine head and trail, which remained visible for a minute or more. A lantern slide of this meteor (made by Mr. Post) was thrown on the screen, and attention was called to the peculiar details of the head and trail. Considering the number and the brilliancy of the meteors which fell during the morning of the 15th, the trails on the plates are unexpectedly few.

Only during the night of November 14–15 was a careful attempt made to count the meteors. Miss Edith Post and Miss Greenough watched the northeastern and the southeastern sky. The observers at the telescope occasionally aided in counting. Four hundred and eighteen meteors, of which all but a very few were well-defined Leonids, were counted. Of these the greatest number was seen between 4.30 and 5.55 a. m., November 15, when 273 were counted. During the last hour the shower was evidently increasing.

The notes on 'Individual Meteors' show that many bright Leonids fell, showing trails which lasted many seconds, and extended 10 to 30 degrees.

Two very brilliant meteors fell at 5.28 a. m., November 15, and their paths crossed each other. One came from the radiant and the other from below Leo and cut the trail of the first under Canes Venatici. The trails were 30 degrees long.

The hope was expressed that next year we would be favored with a shower more brilliant and comparable to the showers of 1833 and 1866.

F. L. TUFTS,
Secretary.

TORREY BOTANICAL CLUB.

THE first paper on the scientific program on December 10, 1901, was by Professor L. M. Underwood on 'The Genus *Gleichenia*.' This was illustrated by specimens and sketches, showing the principal natural types. The paper will be published in full in an early number of the *Bulletin*.

Mrs. N. L. Britton presented 'Notes on Macoun's Recent Collections of Canadian Mosses,' speaking of collections made by Professor J. Macoun during the past summer in the lower peninsula of Ontario between Lake Erie and Lake Ontario. Special mention was made of *Seligeria campylopoda* Kindb., previously known only from Owen Sound, but now collected at Niagara Falls. This moss ordinarily grows in pockets in limestone rocks and being very small is easily overlooked. Mrs. Britton alluded also to the synonymy of *Polytrichum Ohioense* Ren. & Card. This species was distributed by Drummond in his Musci Americani as *Polytrichum pallidisetum* and is apparently the same as what was afterwards recognized in the Manual of Lesquereux and James as *Polytrichum formosum*, var. *pallidisetum*, but whether the original *Polytrichum pallidisetum* of Funk is identical remains to be determined.

Dr. P. A. Rydberg in 'A Review of a Recent Monograph of the Ranunculaceæ' discussed the work recently written by Dr. K. C. Davis.

The final paper was by Mr. S. H. Burnham and was entitled 'Notes on the Flora of the Lake George Region.' Mr. Burnham referred especially to *Bidens Beckii*, an aquatic plant growing in five or six feet of water in muddy streams, and to his experiences in collecting it through the ice during the last week of November of the present year. He also alluded to the restriction of *Castalia tuberosa* to the streams flowing directly into Lake Champlain while *Castalia odorata* alone is found in the Lake George Basin.

MARSHALL A. HOWE,
Secretary pro tem.

NORTHERN SECTION OF THE AMERICAN CHEMICAL SOCIETY.

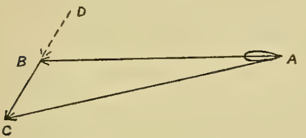
THE regular monthly meeting of the Section was held on Tuesday evening, December 17, in the Kidder lecture room of the Massachusetts Institute of Technology. Professor C. F. Chandler, of Columbia University, addressed the Society on 'The Electro-chemical Industries at Niagara Falls.' After tracing the historical development of electro-chemistry, Professor Chandler proceeded to discuss the development of the Castner process for the manufacture of sodium, sodium hydroxide, peroxide and cyanide, and the utilization of the chlorine from the salt for the manufacture of bleaching powder. The Hall process for the manufacture of aluminium together with the electrolytic purification of bauxite was then discussed and illustrated by a large number of beautiful specimens. The preparation and applications of carborundum, graphite, phosphorus and calcium carbide were considered in detail and were used to illustrate the rapid development of the electro-chemical industries at Niagara Falls.

HENRY FAY,
Secretary.

DISCUSSION AND CORRESPONDENCE.

THE MEASUREMENT OF WIND AT SEA.

TO THE EDITOR OF SCIENCE: In conducting at sea the meteorological observations with kites that have been described in SCIENCE, it was necessary to deduce from the observations on the ship and from the record of velocity at the kite the true direction and velocity of the wind at sea-level and in the upper air, respectively. Knowing the resultant direction and velocity of the wind on the ship or at the kite, as well as the speed of the ship, the triangle of forces gave the true velocity of the wind and its direction relative to the course of



the vessel. For example, let AB be the wind due to the motion of the steamer in the opposite direction and let AC be the wind observed on board, the direction relative to the vessel being indicated by the drift of the smoke and its velocity measured by an anemometer. Then the third side, BC, of the triangle represents the direction of the natural wind and its velocity on the same scale. The problem is not new, for in Abbe's 'Treatise on Meteorological Apparatus and Methods' (*Report of the Chief Signal Officer for 1887, Part 2*), several graphical and mathematical solutions that have been proposed since 1847 are cited, and in the November *Pilot Chart* of the United States Hydrographic Office, a table shows the true direction of the wind with regard to the ship and its force, when there are known, the speed of the ship, the angle that the apparent wind makes with it (points off the bow) and the force of this wind.

It does not seem to be understood, however, that the same result may be reached without any measurement whatever of wind velocity or estimation of force by merely measuring, in addition, the angle that the true wind makes with the ship, which is easily done by watching from the weather side the wave-crests as they approach the vessel. If, in the figure, AB again represent in direction and speed the ship's wind, and AC, in direction only, the resultant wind, then by measuring the angle DBA that the true wind makes with the ship we have, as before, the third side, BC, of the triangle. The method fails when the wind is in line with the ship's course and becomes inaccurate when the angle between them is small. In other cases, since the speed and course of the ship are always sufficiently known and the two angles BAC and DBA can be measured with precision, the method is better than the first because of the difficulty in measuring the resultant velocity, arising from the upward deflection of the wind on striking the ship. When steaming through calm air, experiments with Dines' portable pressure anemometer demonstrated that in few localities on board was the speed of the vessel indicated by the horizontal movement of the air, one such place being just aft of the bow. Elsewhere a less speed was usually recorded, though under the bridge the compressed vein of air flowed astern faster than the boat moved ahead. In view of this difficulty of measuring the apparent wind velocity on a moving vessel, any method of ascertaining the true velocity with considerable accuracy, without employing an anemometer, is desirable from a scientific as well as from a practical standpoint, and, therefore, the simple method last described, which may usually replace the other, is now published for the first time, so far as the writer is aware.

A. LAWRENCE ROTCH.

BLUE HILL METEOROLOGICAL OBSERVATORY, December 10, 1901.

THE ANDREW CARNEGIE RESEARCH SCHOLARSHIP.

A RESEARCH scholarship or scholarships, of such value as many appear expedient to the Council of the Iron and Steel Institute, from time to time founded by Mr. Andrew Carnegie (Vice-President), who has presented to the Iron and Steel Institute sixty-four one-thousand dollar Pittsburg, Bessemer and Lake Erie Railroad Company 5 per cent. Debenture bonds for the purpose, will be awarded annually, irrespective of sex or nationality, on the recommendation of the council of the institute. Candidates, who must be under thirty-five years of age, must apply, on a special form before the end of March to the secretary of the institute.

The object of this scheme of scholarships is not to facilitate ordinary collegiate studies, but to enable students, who have passed through college curriculum or have been trained in industrial establishments, to conduct researches in the metallurgy of iron and steel and allied subjects, with the view of aiding its advance or its application to industry. There is no restriction as to the place of research which may be selected, whether university, technical school, or works, provided it be properly equipped for the prosecution of metallurgical investigations.

The appointment to a scholarship shall be for one year, but the council may at their discretion renew the scholarship for a further period instead of proceeding to a new election. The results of the research shall be communicated to the Iron and Steel Institute in the form of a paper to be submitted to the annual general meeting of members, and if the council consider the paper to be of sufficient merit, the Andrew Carnegie Gold Medal shall be awarded to its author. Should the paper in any year not be of sufficient merit, the medal will not be awarded in that year.

By Order of the Council,
Bennett H. Brough,
28, Victoria Street, London. *Secretary.*

CURRENT NOTES ON PHYSIOGRAPHY.

THE WASHINGTON FOLIO.

The Washington double-sheet folio, by Darton and Keith, embraces a district in which the Potomac flows from its gorge in the Piedmont plateau to its estuary in the Coastal plain. Along the junction of the two areas is an 'inner lowland' similar to that so well developed in New Jersey, but of less breadth. It is determined on one side by the descending floor of crystallines on which the Coastal plain strata rest, and on the other by a pale and ragged 'cuesta' whose sinuous crest appears to be held up by the Matawan formation, overlapped by abundant later deposits, while the lowland itself is opened out on the clays and sands of the Potomac (Cretaceous) formation. The economic sheets give the underground contours of water-bearing strata. The structural sections exhibit the wonderfully even truncation of the steep-dipping crystallines in the Piedmont area. A novel feature is presented on the physiographic geology sheet, where the existing planes and slopes are colored according to the date of their production, and not that of the rocks on which they are carved. This brings out clearly the pre-Columbia dissection of the Lafayette plain, as well as the Columbia and later terraces, the latter having their greatest extension along the inner lowland between the old land and the cuesta.

PHYSIOGRAPHIC ECOLOGY.

'The Physiographic Ecology of Chicago and Vicinity, a study of the origin, development and classification of plant societies,' by Cowles (*Botan. Gazette,* XXXI., 1901, 73–108, 145–182), and 'The Genetic Development of the Forest of Northern Michigan, a study in physiographic ecology,' by Whitford (*ibid.,* 289–325), are essays in which the relation of plant distribution to land forms is carried to much more than ordinary detail. Not only is the existing distribution of plants traced out, but the extension of one plant society and the corresponding restriction of another, with the slow advance of physiographic development, as previously suggested by Woodworth, are here clearly pointed out, as in the discussion of the flora of ravines, valley sides and flood plains.

Studies of this kind are of especial interest to the physiographer from the use that they make of physiographic details; they are encouraging in the evidence that they give that the real intention of physiography is coming to be recognized. It is not so much an end in itself as a means to a larger end; hence it must concern itself not only with large features of earth form and climate, but with local details as well. It is particularly in these applications of physiography that an effective terminology will be demanded, for when the distribution of plant societies is followed out on so gently modulated a surface as that of a flood plain, nothing less than a systematic and detailed method of description will suffice. When not only biologists, but geographers and even travelers come to avail themselves of the results of physiographic study, the need of a careful terminology will be still more apapparent.

THE COAST-PLAIN OF NORWAY.

Under the title 'Søndre Helgelands morfologi' (*Norges geol. undersögelse,* No. 29, 1900, 1–61; German abstract, 160–170), Vogt describes the leading features of a part of mid-western Norway, including a typical portion of the coast plain whose general occurrences and origin by marine abrasion were first announced by Reusch in 1894, and whose forms were further illustrated by Richter (see SCIENCE, June 26, 1896). Between latitudes 63½° and 66½°, the coast plain, now much dissected and mostly submerged, has a breadth of about 45 kil., or a third of that of Norway in this district. It bears some large unconsumed eminences here and there. Its inner border lies along a tolerably direct line at an altitude of from 20 to 50 met., and is well defined by the rather abrupt ascent to the highlands whose altitude shows that some 400 met. of rock was worn away in abrading the inner part of the plain. Further inland, the highlands are too uneven to be regarded as an uplifted peneplain; but they have been heavily denuded, their summits are composed of their hardest rocks, and their summit heights show a marked accordance with a plane sloping seaward at an angle of 40′. Belts of limestone have been worn down in longitudinal valleys by which inland communication is favored. Transverse valleys, now occupied by fiords, lead to the coast. Returning to the coast plain, it slopes gently westward, and as it gradually dips under the sea thousands or tens of thousands of skerries fringe the shore line. Its outer edge is now at a depth of from 10 to 30 met., beyond which the bottom descends more rapidly. The slope of the plain is ascribed in part to post-glacial tilting (2½′), in part to an original declivity due to abrasion as the land slowly sank. The date of abrasion is given as preglacial, and the fiords and other channels by which the plain is intersected are ascribed largely to glacial erosion acting on lines of previously established valleys. The fiords reach depths of from 400 to 600 met. beneath the sea, or from 1,250 to 1,500 met. below the adjoining highlands; their depth decreases forward in the coast plains. The shore lines (strandlinjen) that were cut during the post-glacial submergence stand somewhat higher than the inner border of the abraded plain, with which they should not be confused.

SWEDISH GLACIAL LAKES.

HANSEN has shown that the shore lines of extinct lakes occur in deep east-discharging valleys that occupy a belt next east of the general watershed of the Scandinavian highlands, and that the barriers by which the lake waters were held consisted of residual ice masses; thus confirming the generalization that the iceshed of the glacial period (as determined by striations and boulders) lay somewhat east of the watershed. A special account of some of these lakes is given by Gavelin ('On the glacial lakes in the upper part of the Ume river valley.' *Bull. Geol. Inst. Univ. Upsala*, IV., 1900, 231–242, map). One of these lakes in lat. 66° was over 100 kil. long, with a width up to 9 kil., and a depth of 150 or 200 met. Its outlet was westward across a pass at an elevation of 534 met. Wave-cut terraces in till and stream-built deltas of gravel are traceable round the shore line, which rises eastward with a gradient of about 1:2,000. A higher water level is found at altitudes varying between 700 and 760 met. Many other shore lines of this kind await the attention of the explorer.

W. M. DAVIS.

BOTANICAL NOTES.

POPULARIZING FORESTRY INFORMATION.

MR. ABBOT KINNEY, of Los Angeles, California, has rendered forestry a good service by bringing out a pretty book entitled, 'Forest and Water,' in which he discusses in a non-technical way many things which bear upon our forests and their management as well as their mismanagement. In a series of short chapters the author discusses enthusiastically and earnestly, if not always learnedly, many things pertaining to trees and their environment. Thus he takes up the origin and continuance of forests, forest fires, pasturage in forests, need of government control, forests in relation to torrents, study of the pines, cedars and other trees, some relations between forests and water supply, forest reservoirs, etc. In speaking of forest fires the author says, "Fire is more dreaded than any other destroying agent by those interested in forests." In regard to the pasturing of sheep in the public forests Mr. Kinney speaks very plainly, denouncing the practice in strong terms, as most destructive to the forests. The book is illustrated with half-tone reproductions of striking photographs, which cannot fail to arrest attention. While the literary side of the book leaves something to be desired, there is no question that it will do much good, and the author is to be commended for his effort.

TITLES OF RECENT ARTICLES AND PAMPHLETS.

UNDER the title 'Beitraege zur Kenntniss der Grasroste' Fritz Mueller discusses in 'Beihefte zum Botanischen Centralblatt,' Band X., a new species of *Puccinia* (*P. symphyti-bromorum*) related to Ericksson's *P. dispersa,* and in the course of his paper gives the details of many cultural experiments. The latter will be of much interest to students of the Uredineae who are engaged in similar work —Dr. Th. Valeton, in the 'Bulletin de L'Institut Botanique de Buitenzorg' (VIII.), in an article entitled 'Die Arten der Gattungen *Coffea* L., *Peristomeris* Thw., und *Lachnastoma* Korth., gives the results of a critical study of these genera in the form of careful diagnosis, followed by notes on certain species. *Coffea* is divided into two subgenera, viz., *Eucoffea* (which includes among others the well-known *C. arabica*), and *Paracoffea,* containing six to eight Asiatic and African species.—Robert Hegler's paper, 'Untersuchungen ueber die Organization der Phycochromaceenzelle,' in Pringsheim's 'Jahrbuecher' (Bd. XXXVI.), is important as a contribution to our knowledge of the structure of the cell of Protophytes. He distinguishes what he regards as a genuine nucleus in every cell, and is able to separate this from the cytoplasm. In each he makes out a ground-mass in which is a more deeply staining granular part. In division he describes what appears to be a crude imitation of the karyokinetic stages as seen in higher plants, but his photographs do not certainly sustain this statement.—In the last number of *Hedwigia* (Bf. XL., Hft. 5) Georg Bitter brings to a close his paper, 'Zur Morphologie und Systematic von Parmelia,' in which he has discussed in particular the subgenus *Hypogymnia.*—A notable paper in the September *Annals of Botany* is Margaret C. Ferguson's 'Development of the Egg, and Fertilization in *Pinus strobus,*' in which she notes the similarity between fertilization in the pines and processes known to take place during fertilization in some animals. Three plates of about ninety figures illustrate the paper.—V. S. White's paper, 'The Tylostomaceae of North America,' in the August *Bulletin of the Torrey Botanical Club,* is a valuable contribution to our knowledge of these curious puff-balls. The paper is illustrated with ten plates, including seventy-eight figures.—Dr. Walter Migula, the well-known German botanist, has undertaken to bring out a new 'Kryptogamen Flora' of Germany, which is to constitute the fifth, sixth and seventh volumes of Thome's 'Flora von Deutschland, Œsterreich und der Schweiz.' The first Lieferung takes up the Bryophyta. A feature of the work is to be the use of colored plates for illustrating the text, and the examples given in the first number indicate that this part of the work is to be well done.—Numbers 209 and 210 of Engler and Prantl's 'Pflanzenfamilien' are devoted to the Selaginellaceae, and the fossil members of this family and of the Lycopodiaceae, and in addition, the Lepidodendraceae.—The sixth 'Heft' of Engler's 'Pflanzenreich' has appeared, and we may now judge of the magnitude and importance of the work which Engler has undertaken. These six Heften have treated of the families Musaceae, Typhaceae, Sparganiaceae, Pandanaceae, Monimiaceae, Rafflesiaceae, Hydnoraceae, and Symplocaceae, and to these about four hundred and fifty pages have been given. The illustrations and text maintain the high standard of the earlier numbers.

SUPPLEMENT TO NICHOLSON'S DICTIONARY OF GARDENING.

BOTANISTS and horticulturists will find much of value in the two volumes which constitute the supplement to this well-known work. In 747 pages the editor has succeeded in adding a great amount of new and supplemental matter, and in fact brings the work fairly up to the present. The volumes have the appearance of those which preceded them, and the typography and illustrations are of the high order with which we were familiar in the earlier volumes. The colored plates, which are quite lavishly used, are very fine, indeed; in fact they are not to be excelled anywhere in works of this class. Many of the black illustrations are from photographs which have been reproduced with unusual fidelity. In the text the topics which attract one on account of full treatment are: *Adiantum,* where many additions are made; *Alsophila,* to which two beautiful illustrations are added; *Aquatic Plants,* covering eight pages, and including five fine photographs; *Asplenium,* with forty figures, and covering thirteen pages; *Bedding Plants,* nine pages; *Cacti,* eight pages; *Chrysanthemum,* ten pages; *Cypripedium,* twelve pages; *Ferns,* six pages; *Landscape Gardening,* eleven pages; *Sphingidae,* six pages; *Tulipa,* four pages.

CHARLES E. BESSEY.

UNIVERSITY OF NEBRASKA.

THE CARNEGIE INSTITUTION.

MR. ANDREW CARNEGIE'S great gift of $10,000,000 for scientific research has beeen transferred to a corporation to be known as 'The Carnegie Institution.' The original incorporators are Secretary Hay, Dr. D. C. Gilman, lately president of Johns Hopkins University and director of the Washington Memorial Institution; the Hon. Chas. D. Walcott, director of the U. S. Geological Survey and president of the Board of Trustees of the Washington Memorial Institution; Dr. John S. Billings, U. S. A. (retired), director of the New York Public Library; the Hon. Edward D. White, associate justice of the Supreme Court of the United States, and the Hon. Carroll D. Wright, U. S. Commissioner of Labor. The original incorporators will select a board of from 27 to 30 trustees.

The preamble of the articles of incorporation is as follows:

We, the undersigned, persons of full age and citizens of the United States and a majority of whom are citizens of the District of Columbia, being desirous to establish and maintain in the City of Washington, in the spirit of Washington, an institution for promoting original research in science, literature and art, do hereby associate ourselves as a body corporate for said purposes under an act to establish a code of law for the District of Columbia, approved March 3, 1901, Sections 599 to 604 inclusive.

The objects of the institution, in addition to the promotion of research, are set forth as follows:

To acquire, hold and convey real estate and other property necessary for the purpose of the institution and to establish general and specific funds.

To conduct, endow and assist investigation in any department of scientific literature or art, and to this end to cooperate with governments, universities, colleges, technical schools, learned societies and individuals.

To appoint committees of experts to direct special lines of research.

To publish and distribute documents, to conduct lectures and to hold meetings.

To acquire and maintain a library and, in general, to do and perform all things necessary to promote the objects of the institution.

SCIENTIFIC NOTES AND NEWS.

SOME account of the recent meeting of the American Society of Naturalists and the affiliated societies will be found at the beginning of the present issue of SCIENCE. The address of the president, Professor Sedgwick, is also printed above. It may be added that the society took action commending a national board of health and the preservation of the remains of the cliff-dwellings in Arizona. The sum of $50 was appropriated toward the University table at the Naples Zoological Station. A committee was appointed, consisting of Professors Minot (chairman), Sedgwick, Cattell, Wilson and McGee, to confer with a similar committee to be appointed by the naturalists of the Central and Western States in regard to the relations of the two societies. The officers elected for next year are as follows: *President,* J. McKeen Cattell, Columbia University; *Vice-Presidents,* C. D. Wolcott, U. S. Geological Survey, L. O. Howard, Department of Agriculture, and D. P. Penhallow, McGill University; *Secretary,* R. G. Harrison, Johns Hopkins University; *Treasurer,* M. M. Metcalf, Woman's College, of Baltimore; *Members of Executive Committee,* W. T. Sedgwick, Massachusetts Institute of Technology, and E. B. Wilson, Columbia University.

A meeting of naturalists of the Central States was held at Chicago, January 2, 1902, and it was voted to organize a society of naturalists of the Central States. A committee of five was ordered to be appointed by the presiding officer, Professor S. A. Forbes, to confer with a committee to be appointed by the American Society of Naturalists, and also to report a form of organization and to nominate members in accordance with the constitution of the American Society of Naturalists. It was voted to meet next year during convocation week at Washington.

A meeting of zoologists of the Central and Western States was held at Kent Theater, Chicago, January 2, 1902. Professor Davenport was chosen moderator. A committee of three was appointed, consisting of Professors Forbes, Reighard and Davenport, to draw up a constitution. It was voted to meet next convocation week at Washington.

The American Morphological Society elected the following officers for 1902: *President,* H. C. Bupmus; *Vice-President,* G. H. Parker; *Secretary* and *Treasurer,* M. M. Metcalf; *Executive Committee,* H. S. Jennings and R. G. Harrison.

The officers elected by the Association of American Anatomists are as follows: *President,* G. S. Huntington, New York; *Vice-President,* D. S. Lamb, Washington; *Secretary* and *Treasurer,* G. Carl Huber, Ann Arbor; *New Members of Executive Committee,* C. A. Hamann, Cleveland, George A. Piersol, Philadelphia, and F. H. Gerrish, Portland, Me.

The American Psychological Association elected officers as follows: *President,* E. A. Sanford, Clark University; *Secretary* and *Treasurer,* Livingston Farrand, Columbia University; *New Members of the Council,* G. S. Fullerton, University of Pennsylvania, and G. T. W. Patrick, Iowa State University.

At the recent Rochester meeting of the Geological Society of America the following officers were elected: *President,* N. H. Winchell, Minneapolis; *First Vice-President,* S. F. Emmons, Washington; *Second Vice-President,* J. C. Branner, Stanford University; *Secretary,* H. L. Fairchild, Rochester, N. Y.; *Treasurer,* I. C. White, Morgantown, W. Va.; *Editor,* J. Stanley-Brown, Washington; *Librarian,* E. P. Cushing, Cleveland, O.; *Councillors,* C. W. Hayes, Washington, and J. P. Iddings, Chicago.

Captain Alfred T. Mahan, U. S. N. (retired), known for his publications on naval and military problems, has been elected president of the American Historical Association. The Association will meet next year at Philadelphia.

Col. Jacob L. Greene, of the Connecticut Mutual Life Insurance Co., has been elected president of the Hartford Scientific Society, in place of Dr. Geo. L. Parmele, who declined reelection.

Professor Virchow, while stepping from a trolley car in Berlin on January 5, fell and was so much injured that it was necessary to carry him to his house.

Mayor Low has appointed Mr. Ernst J. Lederle health commissioner of New York City, with Dr. Herman M. Biggs as medical officer, having charge of the medical affairs of the board. J. M. Woodbury, M.D., has been appointed street cleaning commissioner.

Dr. Arthur Smith Woodward, F.R.S., has been appointed keeper of geology in the British Museum in succession to Dr. Henry Woodward, F.R.S., who recently retired. It is rumored that Dr. A. S. Woodward is likely to be succeeded in the assistant keepership by Dr. Francis Arthur Bather, who has been an assistant in the museum since 1887. Dr. Bather is one of the most distinguished members of the modern school of paleontology in Europe, and is a frequent contributor to Science. He is personally known and esteemed by a large circle of scientific friends in this country.

Dr. William Somerville, late professor of agriculture at the University of Cambridge, has been appointed to be an assistant secretary to the board of agriculture on the retirement of Sir Jacob Wilson.

MR. FRANCIS J. E. SPRING, senior inspector of railways in India, has been given the degree of Master of Engineering at Dublin University. It is doubtful whether Mr. Spring's valuable services for thirty years on the railways and other engineering works in India enabled him to understand the Latin oration given on the occasion by the public orator, Dr. R. Y. Tyrrell.

MR. WILLIAM HUNTER, assistant to the bacteriologist to the London hospital, has been appointed government bacteriologist to the Colony of Hong Kong.

DR. SAMUEL CALVIN, state geologist of Iowa, recently delivered a lecture on the 'Ice Age in Iowa' before the science teachers at the Iowa State Teachers' Association.

PROFESSOR T. D. A. COCKERELL has been elected a correspondent of the Philadelphia Academy of Natural Sciences.

DR. H. M. SAVILLE, of the American Museum of Natural History, left Mexico City on December 31, to continue explorations of the ruins in the Oaxaca Valley.

PROFESSOR LAWRENCE BRUNER, who has on several former occasions visited the warmer portions of North and South America for similar purposes, is contemplating a trip to Costa Rica during the months of February, March and April for the purpose of collecting material for his and other departments in the University of Nebraska. While primarily thus employed, he would be pleased to undertake the collection of material for other institutions when such collecting would not too greatly interfere with the outlined work of the expedition. Other members of the party have also had experience in field work. This expedition is not undertaken entirely in the interests of the University of Nebraska and the funds to pay the expenses of the same are to be supplied only in part by that institution, and it is expected that the commissions undertaken for others would in a measure meet this deficiency. Any person or institution wishing to learn further particulars concerning this proposed expedition is requested to correspond with Mr. Bruner at the University of Nebraska. It is planned to sail from New Orleans on or about February 14, 1902.

A CABLEGRAM to the New York *Sun* from St. Petersburg reports that the expedition under Dr. Herz, which was sent to Kolymsk by the St. Petersburg Academy of Science, has arrived at Srednokkolynsk with the remains of a male mammoth. The hide is in an almost complete state of preservation. In the stomach and teeth the remains of undigested food were discovered.

WE learn from *The British Medical Journal* that on December 10 a bronze medallion portrait of the late Professor Thomas Jones, which has been placed in Owens College Medical School, was unveiled in the presence of a large gathering of friends and students. At the same time a brass tablet bearing the names of Professor Jones and those of Dr. Davies, Mr. Eames and Dr. Aldred, former medical students of the college, who also lost their lives in the South African war, was unveiled. The total sum contributed by 275 subscribers to the memorial was £978, and Professor Wright, the treasurer, after defraying the cost of the medallion and tablet, was able to hand over £852 to the college authorities for the foundation of an exhibition in anatomy.

MR. EDMUND WILLIAM SMITH, archeological surveyor of the northwestern provinces of India, died of cholera on November 21, at the age of forty-three years. He had an important work in preserving archeological remains and in publishing descriptions and drawings.

MR. HENRY GEORGE MADAN, senior fellow of Queen's College, Oxford, and for twenty years head of the science department at Eton, died at Gloucester on December 21. He was a fellow of the Chemical Society and was joint author with Mr. A. G. V. Harcourt, of Christ Church, of 'Exercises in Practical Chemistry,' now in its fifth edition, and of other smaller works on chemistry and physics.

WE regret also to record the deaths of Professor J. H. Chievitz, director of the Anatomical Museum at Copenhagen, of Dr. Carl

Cramer, professor of botany in the Technical College at Zurich, and of Professor Henry Settegast, director of the Agricultural Institute at Jena.

Sir Ernest Cassel has given through King Edward £200,000 for a sanitarium for consumptives. The King has appointed an advisory committee, composed of leading physicians, including Sir William Henry Broadbent, Sir Richard Douglas Powell, Sir Francis Henry Lacking, and Sir Felix Semon. Three prizes of £500, £200 and £100, respectively, have been offered in connection with this scheme, for the best essays on, and plans for, the construction of the sanitarium. The competition is open to medical men of all nationalities.

By the will of Miss C. B. De Peyster, the New York Historical Society, will, on the death of her sisters, receive an estate of $130,-000.

UNIVERSITY AND EDUCATIONAL NEWS.

Oberlin College has collected the $300,000 necessary to secure the $200,000 offered by Mr. John D. Rockefeller a year ago, and thus increases its endowment by $500,000. Barnard College, Columbia University, has not been so fortunate in fulfilling the terms of Mr. Rockefeller's offer of $200,000, but Mr. Rockefeller has extended the time to April 1.

Four trustees of the Worcester Polytechnic Institute, Messrs. S. Salisbury, C. H. Whitcomb, C. H. Morgan and C. G. Washburn, have given $30,000 to the institute. Part of the money will be devoted to the erection of a new foundry and forge shop.

Sir William MacDonald has placed $125,-000 at the disposal of the Ontario Government to be used in the erection of buildings at the Guelph Agricultural College, for the purpose of giving instruction to school teachers in the elements of nature-study and domestic science.

Lord Strathcona has given £25,000 to Aberdeen University.

The sum of about $80,000 has now been contributed toward the endowment of the chair of political economy and social science at Washington and Lee University in memory of the late William L. Wilson. $100,000 must be collected, and it is hoped that subscriptions will be sent to the treasurer of the fund, Mr. Herbert Welch, 1305 Arch Street, Philadelphia, Pa.

It is said that M. Robert Lebaudy has offered $25,000 towards the establishment of a French industrial school in connection with the University of Chicago. The new school is to be an integral part of the University and the necessary buildings will be located on the campus. The purpose of the school is the systematic study of American industrial and business methods. The students will consist of 600 graduates of French colleges, who will be selected by the French Government.

A deputation, representing the English university colleges of Bristol, Dundee, Leeds, Liverpool, London, Manchester, Newcastle (Durham College of Science), Nottingham and Sheffield, recently visited the chancellor of the exchequer to urge an increase in the grant of £25,000 distributed among the colleges. No hope, however, was given that the grant would be increased, except in so far as new colleges may receive small grants.

Mr. Walter Palmer, M.P., has given £2,000 to the University of London to provide the apparatus required for the proposed post-graduate courses of lectures in physiology.

At the University of London, university scholarships have been awarded as the result of the recent B.A., B.Sc., and M.B. examinations to the following: Classics, H. G. Wood; mathematics, F. Slator; chemistry, G. Tattersall; zoology, H. M. Woodcock; experimental physics, J. Satterly; medicine, C. J. Thomas; obstetric medicine, A. E. Jones; forensic medicine, E. M. Sharp.

Dr. G. E. Fellowes, assistant professor of history in the University of Chicago, has been elected president of the University of Maine.

Dr. D. A. Welsh, senior assistant to the professor of pathology in the University of Edinburgh, has been appointed to the chair of pathology in the University of Sydney.

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 17, 1902.

CONTENTS:

THE GEOLOGICAL SOCIETY OF AMERICA.

THE fourteenth annual meeting of the Geological Society of America was held in Rochester, N. Y., from Tuesday, December 31, 1901, to Thursday, January 2, 1902. An informal session of the Council, to canvass the ballots for officers and fellows, was held on Monday night, December 30, at the Whitcomb House, the headquarters of the Society. A formal session of the Council was held at 9 o'clock Tuesday morning in Sibley Hall, University of Rochester.

Owing to the unavoidable absence of President Walcott, the meeting was called to order by Professor Newton H. Winchell, shortly after 10 o'clock, in the geological lecture room of the University of Rochester, and the address of welcome and response were postponed until the arrival of the president. The report of the Council and officers having been printed and distributed to the members, its consideration was laid over until Thursday. Professor R. E. Dodge and Dr. E. O. Hovey were then appointed auditing committee. The vote for officers for 1902 was declared as follows:

President, N. H. Winchell, Minneapolis, Minn; *First Vice-President*, S. F. Emmons, Washington, D. C.; *Second Vice-President*, J. C. Branner, Stanford University, Cal.; *Secretary*, H. L. Fairchild, Rochester, N. Y.; *Treasurer*, I. C. White, Morgantown, W. Va.; *Editor*, J. Stanley-Brown, Washington, D. C.; *Librarian*, H. P. Cushing, Cleveland, O.; *Councillors*, C. W. Hayes, Washington, D. C., J. P. Iddings, Chicago, Ill.

The following were declared elected fellows of the Society:

Ermine Cowles Case, A.B., A.M. (Kansas State University, 1893), M.S. (Cornell Univ., 1895), Ph.D. (Univ. of Chicago, 1896), Instructor in State Normal School, Milwaukee, Wis.; Arthur Gray Leonard, A.B., A.M. (Oberlin), Ph.D. (Johns Hopkins Univ.), Des Moines, Iowa, Assistant State Geologist, Iowa Geological Survey; Charles Hyde Warren, Ph.B. (Yale, 1896), Ph.D. (Yale, 1899), Boston, Mass., Instructor in Geology, Mass. Inst. Technology.

The following memorials were read: George M. Dawson, by Frank D. Adams; Ralph D. Lacoe, prepared by David White, read by the secretary; Theodore G. White, prepared by J. F. Kemp, read by R. E. Dodge.

The following memorials were not read, owing to the absence of the authors: Edward W. Claypole, by Theo. B. Comstock; Joseph Le Conte, by W J McGee.

President Walcott, having meanwhile arrived, took the chair, and the address of welcome was delivered by Dr. Rush Rhees, president of the University of Rochester. He complimented the Society on its work, and the city and University of Rochester on the honor conferred by the meeting of the Society within their confines. He saw no special reason why Rochester should be so favored, but hoped that this meeting would stimulate its citizens to take a deeper interest in higher education. Finally he welcomed the Society most cordially to the University and the city. President Walcott, in responding, offered many reasons why the Society should meet in Rochester, for that city was intimately connected with the early study of geology in this country, and from it have proceeded many eminent members of the Society.

The following scientific papers were then read:

The Ordovician Succession in Eastern Ontario: H. M. Ami, Ottawa, Canada.

This paper dealt with the succession of paleozoic sediments in that portion of the province of Ontario, Canada, which is traversed by the Frontenac axis or ridge of Archæan rocks which crosses the St. Lawrence river between the city of Kingston and Brockville and connects with the great Adirondack massif to the south.

The Frontenac axis divides the Ordovician strata, to the east as well as to the west, into two series, which, though not very distant, geographically speaking, are nevertheless marked by important features.

On the east side of the axis the normal succession of strata from the Potsdam to the Medina is found, but on the west side of the axis the pre-Cambrian rocks are overlain by the Rideau sandstone, succeeded without stratigraphic break by the Birdseye, Black River and Trenton strata. Fossils, except *Scolithus*, are absent in the Rideau sandstone and the problem of the equivalency of this sandstone was stated.

In the discussion Mr. Bailey Willis considered that the Rideau sandstone is the formational equivalent of the Potsdam, but not its equivalent in age. Professor W. M. Davis considered it pre-Black-river in time, but of unsettled age. Mr. Walcott, emphasizing the shifting character of the deposits around the Adirondacks, suggested that the Rideau was the shore equivalent of the Calciferous (Beekmantown) and Chazy.

Stratigraphic and Faunal Succession in the Hamilton Group of Thedford, Ontario: Hervey W. Shimer and A. W. Grabau, New York, N. Y. Read by Mr. Shimer.

The Thedford Hamilton admits of a three-fold division, closely corresponding to that of the Hamilton of western New York. The limitations of the characteristic species correspond in a remarkable degree to those observed in western New York. The encrinal limestone is the central member in both localities, and the chief coral zone lies just above this stratum in both. A striking dissimilarity exists between the Hamilton of Thedford and the corresponding horizon (Traverse group) of Alpena, Michigan, the next important outcrop of this formation to the northwest. The difference is shown chiefly in the faunas. The paper was discussed by J. M. Clarke, H. S. Williams and A. W. Grabau.

The Traverse Group of Michigan: AMADEUS W. GRABAU, New York, N. Y.

Two sections, one on Thunder Bay and the other on Little Traverse Bay, show the strongly calcareous facies of the strata, which is most marked in the western section. In both sections the upper limit of the Traverse groups is marked by the St. Clair Black shale, and the lowest portion of the group is a bed of blue clay 80 feet thick. The fauna varies with the rock. The reef character of the limestone strata was discussed. The faunal character of the strata was discussed by Professor H. S. Williams, and the reef structure by Mr. Chas. D. Walcott. The Society then adjourned for lunch, many members availing themselves of the opportunity offered to inspect Ward's Natural History establishment, where a lunch was provided.

The afternoon session was called to order at 2 o'clock. The following papers were read:

The Lower Carboniferous Area in Indiana: T. C. HOPKINS, Syracuse, N. Y.

The Lower Carboniferous strata in west central Indiana undergo quite marked changes along the strike. The outcrops have been traced in detail and represented on the State map. The heavy calcareous deposits of the southern part of the area thin out to the northward and give way to argillaceous and sandy deposits. This transition has an important bearing on the geological history of this region.

The following subdivisions, based on lithologic but not paleontologic features, were discussed. *Kaskaskia, Mitchell, Bedford; Harroddsburg and Knobstone.*

The paper was briefly discussed by W. B. Scott, J. B. Wolf and W. M. Davis. Dr. A. C. Lane discussed the relations of similar beds in Michigan, and raised the question as to the origin of the silica in the beds under consideration, and its value as a horizon marker. He suggested that it might be supplied by volcanic eruptions, even from a distance. Mr. Walcott briefly discussed the economic importance of the limestones of these formations. Brief remarks were also made by Dr. A. F. Foerste, and responded to by Dr. Hopkins.

Geological Horizon of the Kanawha Black Flint: I. C. WHITE, Morgantown, W. Va.

The first comprehensive description of the Kanawha Black Flint was given by W. B. Rogers, and besides this, the works of Stevenson, the Platt Brothers and H. M. Chance were considered as having added most to our knowledge of the details of the Appalachian carboniferous stratigraphy. The name Conemaugh, proposed by Franklin Platt, has, according to W. B. Clark, priority over Elk River series applied to the 'Barren measures' of Rogers, by White. Platt's name was accepted for the beds lying between the Pittsburg coal and the Upper Freeport coal. The position of the Kanawha Black Flint is at the base of the Conemaugh series, though David White places it some 200 feet down in the Allegheny series from paleobotanic evidence. The work of Messrs. Campbell and Mendenhall was reviewed, the speaker disagreeing with their interpretations. The problem was attacked anew by the speaker and from a new standpoint, by tracing the basal coalbed, and the accompanying Mahoning sandstone, as well as the Red bed series with its included crinoidal limestone, from the Pennsylvania line to West Virginia. The results of this new work were in close agreement with those arrived at by the speaker in previous studies. The speaker concluded with the following corollaries:

A. Some coal beds, limestones and sandstones may be followed for hundreds of miles.

B. Stratigraphy is superior to paleobotany in correlations.

C. Paleobotany should be used merely as an aid to stratigraphy.

The paper brought out a warm discussion, in which Professor Stevenson, Bailey Willis, I. C. White and others participated.

President Walcott read a telegram of greeting from the Cordilleran section of the Society, in session in San Francisco, Cal. On motion of Professor Stevenson a similar greeting was returned.

The next paper read was:

Correlation of the Coal Measures of Maryland: Wm. B. Clark and G. C. Martin, Baltimore, Md. Read by Professor Clark.

The object of this paper was to show the equivalency of the coal seams of Maryland with those of adjacent regions in Pennsylvania and West Virginia. The determination of this equivalency is based not only on the parallelism of lithologic sequence over wide areas, as shown both by the structure of the seams themselves and of the intervening beds, but also on the fossiliferous zones which have been found at numerous points throughout this district. The similarity of the chemical composition in each vein over wide areas is also strikingly shown.

Local names, heretofore used by the Maryland survey, were abandoned, and those used in Pennsylvania and West Virginia were adopted. The paper was discussed by I. C. White, J. J. Stevenson and Bailey Willis.

Areal Distribution of the Potomac Group in Maryland: W. B. Clark and A. Bibbins, Baltimore, Md. Read by W. B. Clark.

The lowest member of the Atlantic coastal plain series is the Potomac group, so named by W J McGee, who considered it a single unit. The age of this group was considered to be Cretaceous by paleobotanists, and Jurassic by Marsh and other vertebrate paleontologists. The authors have described a fourfold division of the Potomac into Patuxent, Arundel, Patapsco and Raritan beds, and indicated the distinctive characters of each. The areal distribution, which varies for the different members, was briefly discussed by the speaker. Marsh found Dinosaur remains in the Arundel, which, with the underlying Patuxent beds, is Jurassic. The plant remains were found in the upper or Raritan beds, and these are cretaceous. The lower members gradually die out northward, the Patuxent and Arundel not occurring in New Jersey, though some of the lower members appear to be present in Pennsylvania. The disappearance is due to a northward transgression of the sea and a consequent overlap of the newer upon the older beds. The paper was briefly discussed by Professors Hopkins and Holmes, and questions answered by Professor Clark.

On some Joint Veins: G. K. Gilbert, Washington, D. C.

A limestone stratum between beds of Cambrian shale from western Utah shows innumerable veinlets of the segregation type. In a small hand specimen passed around, 180 veins were counted. These belong to 22 systems, which are grouped in two groups, the minor of which is aligned with the dip of the strata (which is from 10 to 15 degrees) and the major group with the strike. They are believed to be formed along joints. The dip joint-veins are normal to the plane of stratification, the strike veins vary from normal to the stratification, to verticality, and appear to have been formed at different periods. The grouping of the joint-veins in two directions appears in all the beds examined. The scale of the jointing is related to that of the bed, which is a thin one.

Professor J. E. Wolf discussed the origin of the jointing by contraction of the rock on loss of water.

Professor B. K. Emerson considered that they had all the aspect of torsion joints as produced in glass artificially. He referred to Crosby's theory, according to which an earthquake shock, passing through a stratum in which a slight torsion was induced, would produce the joints of the type described. Gilbert considered Crosby's theory the most plausible, and that the shrinkage theory was not applicable here. Bailey Willis thought that expansion of the rocks may have been a cause in the fracturing. Gilbert emphasized the fact that no apparent cracks existed. N. H. Winchell mentioned similar phenomena in the Minnesota mica schists, which apparently were basic sediments. A. C. Lane recalled joints of similar type but larger scale in the diabase sheet of Nahant, Mass.

Regeneration of Clastic Feldspar: N. H. WINCHELL, Minneapolis, Minn.

The literature was reviewed and the speaker's own observations given. Three phases of alterations of clastic feldspars occur: (1) Decay, (2) secondary enlargement, (3) secondary enlargement but the newly added material extended so as to grow into crevices between the other grains of the rock.

The Society then adjourned.

The evening session of the Society was opened at 8:40 o'clock in the college chapel, Anderson Hall. President Charles D. Walcott delivered the annual address, his subject being: 'The Outlook of the Geologist in America.' He reviewed the work now in progress in this country, and sketched a bright future for American geology.

Second day, Wednesday, January 1, 1902. The Council of the Society met in session at Sibley Hall at 9 o'clock.

The meeting of the Society was called to order at 9:50 by President Walcott. The motion was made that the previously distributed report of the Council be accepted. Carried.

The report of the photograph committee, prepared by N. H. Darton, was read by the secretary. The report was accepted, and the usual appropriation voted.

Professor Dodge presented the report of the auditing committee, stating that the committee had examined the treasurer's accounts and found them correct. The report was accepted. The Council recommended that the name of the western section of the Society be pronounced Cor-dil-ya'ran, which is the Spanish pronunciation, used in California. The recommendation was adopted.

The Society then proceeded to the reading of papers:

Geology of the Snake River Plains, Idaho: ISRAEL C. RUSSELL, Ann Arbor, Mich.

In the Snake river basin are many old rhyolitic cones covered by lava flows of later origin. The extent and thickness of the Snake river lava and its relation to the Columbia river lava were discussed. There is a decided lack of evidence of fissure eruption in the Snake river area. The distinction between the cinder and lava cones was illustrated, and various types of lava from the flows were shown.

The characteristic ridges on the older lava streams are due to basal compression of folds on the surface of the stream, these folds sometimes being hollow at the top, though compressed below. Lantern views and specimens illustrated these features. Along cracks in the lava streams, parasitic cones are built up and these and numerous other characters of the lava stream were illustrated by lantern views. Where the lava stream has come in contact with a body of water, the base of the sheet expands and becomes cellular, although the character of the lava is glassy from rapid cooling. The sand of the lake or river bottoms into which the lava stream entered is often cemented into the base of the sheet, and gives it a white color.

The canyon of Snake river owes its peculiarities to many of the features discussed. Shoshone falls are due to a cone or mass of hard rhyolite beneath the basalt, discovered by the river. Heavy lava sheets overlie the finely stratified, unconsolidated lake beds exposed in the canyon, which are scarcely altered by the lava. The base of the latter is glassy, with a few steam holes, but at a short distance above, the sheet has its normal granular character. From beneath the lava stream or from a porous layer, numerous powerful springs issue along the side of the canyon below Shoshone falls. These may be called 'canyon springs,' a new term introduced in the classification of springs. In the northern wall of the canyon occur remarkable spring-formed alcoves or side canyons, which widen out amphitheater-like, and have no stream at their head. Powerful springs, issuing from the fine lacustrine beds underlying the lava, undermine the latter and cause recession of the walls. Numerous lantern views were used in illustration of the paper.

Professor Emerson discussed the origin of these lava beds and their surface characters. He pointed out the similarity of many features of these lavas to those of the Hawaiian volcanoes. He compared the base of the Snake river lava, resting on fine lake beds, with that of the Triassic trap of the Connecticut Valley, resting on the Triassic sands.

Professor Wolff discussed the age of the lava flows and cones.

Structure of the Front Range, Northern Rocky Mountains, Montana: Bailey Willis, Washington, D. C.

The Front Range of the northern Rockies consists of a series of limestones, quartzites and silicious argillites somewhat exceeding 9,000 feet in thickness, and gently flexed in a synclinal form. The width of the range is approximately twenty miles from foothill to foothill, and the synclinal structure has practically a corresponding extent. The trend of the range is from northwest to southeast, and the strike of the rocks is essentially parallel to it. The mass is, however, not exactly symmetrical in cross section, the rocks outcropping on the northeastern side comprising probably 3,000 feet of strata lower in the series than the lowest on the western side.

Approached from the east, the margin of this synclinal mass is found to rest discordantly upon black clays and sandstones. These strata appear at some little distance from the range in the Great Plains, dipping deeply southwestward, but where they pass beneath the great limestone and quartzite series they correspond very nearly in attitude with the overlying rocks. The relation of the overlying to the underlying series is, however, that of an overthrust mass. In many places the black shales and sandstones were found to contain Inoceramus and Ostrea characteristic of the Cretaceous. In the overlying rocks Mr. Weller fortunately found fragments of fossils which have been determined by Mr. Walcott as identical with those discovered by him in the pre-Cambrian Belt formation. Thus the discordance corresponds to an hiatus of all of the Paleozoic and part of the Mesozoic. The plane of overthrust dips gently to the southwest, and is exposed at right angles to its strike throughout a section seven miles in length, which is equivalent to a displacement of that amount. There are interesting details of structure in the overthrust and underthrust masses.

On the western side of the range parallel to the valley of the North Fork of the Flat Head the ancient limestones and quartzites present a bold face, and the stratigraphic relations of rocks found west of the Flat Head valley indicate that this face is a deeply eroded fault scarp of the normal type. The valley of the North Fork of the Flat Head contains lake beds, which are by analogy with similar formations in Montana tentatively referred to the Miocene or Pliocene.

From these data it is inferred that the structural history of the range comprises:

First. Deposition of Cretaceous sediments of very considerable thickness adjacent to a shore not far from the present site of the range and upon a land whose surface consisted of the pre-Cambrian limestones and quartzites.

Second. That in some post-Cretaceous epoch compressive strains resulted in a fold overturned toward the northeast, and ultimately in the development of a corresponding overthrust fault.

Third. That at some later date, probably Miocene, normal faulting resulted in relative uplift of the mass of the front range and downthrow of the mass of the Flat Head valley.

The next paper was a continuation and illustration of the preceding one, numerous lantern views being shown:

Physiography of the Northern Rocky Mountains: BAILEY WILLIS, Washington, D. C.

Professor Coleman discussed the physiography and origin of the structure of the region to the north of that described by Bailey Willis. Professor Davis discussed the structure and physiography of the region described. Mr. Walcott compared the section of pre-Cambrian rocks of the Belt Mountain terrane with that given by Willis in the Northern Rockies, and considered the probability that the entire series involved in the front range is Algonkian.

The Walls of the Colorado Canyon: W. M. DAVIS, Cambridge, Mass.

The general profile of the canyon walls depends on rock structure, and not on a pause in the elevation of the plateaus. The variation of profile from the narrow canyon in the Uinkaret plateau to the wide canyon in the eastern Kaibab is due to variation in the character of the strata. The pattern of spurs and recesses varies with the stage of dissection. The pattern commonly seen in the Red-wall cliffs is repeated in the Tonto cliffs where the latter are much worn. The pattern usually seen in the Tonto is repeated in the Red-wall where it is less worn. Brief mention was made of details connected with the unconformities seen in the canyon walls.

The paper was illustrated by lantern views, and was briefly discussed by Mr. Walcott and others.

The Society then adjourned for the noon recess.

The papers of the afternoon session were:

Rock Basins at the Helen Mine, Michipicoton: A. P. COLEMAN, Toronto, Canada.

Two small lakes or ponds, each a quarter of a mile long and two-thirds as wide, just west of the Helen iron mine near

Michipicoton on the north shore of Lake Superior, present very interesting examples of rock basins. Unlike most of the smaller rock basin lakes of Canada, they are not of glacial origin and probably were not even scoured out by the ice, since they are narrowly enclosed by steep, rocky ridges rising about 150 feet to the north and south and 450 feet toward the east. The shape of the valley is somewhat like that of an armchair with its back to the east, the two ponds, called Boyer and Sayers lakes, occupying the narrow seat. They had a depth of from 125 to 150 feet in the beginning, but Boyer lake, the higher one, is now partially pumped out to facilitate mining operations. From Boyer to Sayers lake the fall is 25 feet; and from Sayers to Talbot lake, which is beyond the high rock walls of the valley, there is a drop of 75 feet.

The valley of the two ponds is cut from rocks belonging to the iron range, chiefly siderite and granular silica banded with magnetite or heavily charged with pyrite, and the lowest point of the rim of each consists of silicious siderite containing much pyrite. The side walls of the valley are of greenish schists. The hollowing of the basins must have been due to solution, perhaps of parts of the iron range rocks which had been shattered; and the deposit of the large ore body at the eastern end of Boyer lake, where a high hill, consisting largely of impure siderite, drops steeply down to the basin, probably has a bearing on their formation, the decomposition of pyrite perhaps furnishing the solvent.

The next paper was:

The Effect of the Shore Line on Waves: W. M. Davis, Cambridge, Mass.

The paper was a statement of the transformations of waves as they run in upon shore lines of different forms, with special reference to the refraction of waves on headlands and in bays, and to the formation of surf.

The breaking of waves is not so much due to a retardation by friction of the base of the wave in shallow water, as generally assumed, as to the absence of water in front of the wave near the shore.

The next paper was:

Variation of Geothermal Gradient in Michigan: Alfred C. Lane, Lansing, Mich.

The geothermal gradient in Michigan appears to vary from 1° F. in 107 feet to 1° in 54 feet. Among the different causes of variation, the varying diffusivity of the rocks appears to be important.

Diffusivity varies with the density; the more porous the rock, the smaller the diffusivity. The limestones of Cheboygan have a diffusivity paralleling that of the copper-bearing rocks of Kewenaw Point. The diffusivity of the shales of Michigan is widely at variance with that of the limestones.

The next two papers were presented together and illustrated by lantern views:

Origin and Distribution of the Loess in Northern China and Central Asia: George Frederick Wright, Oberlin, O.

Detailed observations in China, Mongolia, and Turkestan were presented which bear upon the fluvio-glacial theory of the origin of the loess of these regions, and of its distribution by wind or water.

No evidence of glaciation is found where Geikie and Krapotkin assumed it.

The Age of Lake Baikal: George Frederick Wright, Oberlin, Ohio.

The region about Lake Baikal is covered with strata of Tertiary (and possibly Triassic) age, containing coal. These beds are derived from the sediments which were carried by now existing streams into the basin from the surrounding mountains, before the present lake came into existence. At the estimated rate of erosion the entire lake would be filled in 400,000 years, whereas it is not a quarter full, and probably not one tenth full. The age of Lake Baikal is perhaps 100,000 years or less. That this region was formerly connected with the sea is shown by the species of seal found in Lake Baikal, which are also found in the Caspian sea. Other evidence of recent submergence followed by reelevation exists. A period of increased precipitation caused the freshening of all the waters of the inland lakes of this region.

Professor Scott discussed the importance of æolean action in the formation of stratified beds, referring to those of Santa Cruz in Patagonia, in which vertebrate remains have been found finely preserved.

On Some Anticlinal Folds: T. C. HOPKINS and MARTIN SMALLWOOD, Syracuse, N. Y. Read by Professor Hopkins.

A number of unique folds occur in several small and rather deep ravines in the vicinity of Meadville, Pa. They are of limited extent both vertical and linear, and so far as known occur only in the bottom of the ravines. The relation of the folds to certain land-slip terraces, suggests a cause for these folds which are often asymmetrical.

Professor I. C. White referred to similar folds in other portions of Pennsylvania. He considered that gas formed below found an opportunity to escape in the relatively weak bottoms of canyons, causing an upward pushing of the strata. Professor Brigham mentioned the occurrence of similar folds in western New York. Professor Russell recalled folds, in the bottoms of canyons in western Idaho, where the strata are sharply arched. Land-slip terraces occur on both sides, there being thus no unequal pressure. He considered that the downward pressure of the wall rocks of the canyons, and the relief of pressure in the bottom, caused the arching. Professor Stevenson discussed other folds in Pennsylvania. Mr. C. J. Sarle mentioned folds in the Clinton beds at Rochester and other localities.

The following papers were then read by the author:

Distribution of the Internal Heat of the Earth: T. C. CHAMBERLIN, Chicago, Ill.

Has the Rate of Rotation of the Earth Changed Appreciably During Geological History? T. C. CHAMBERLIN, Chicago, Ill.

The papers were a discussion of the mathematical and physical principles involved, and the available experimental data. The geological application to the phenomena of volcanoes, mountain foldings, etc., and to the great questions of physical geology was discussed.

In discussion some remarks were made by Professor Coleman.

The Society then adjourned until the next day.

The annual dinner was served at eight o'clock at the Whitcomb House. President Walcott occupied the head of the table, which was graced by the presence of a number of ladies. The after-dinner speeches touched upon the future policy of the Society and other topics, and contributed largely to the enjoyment of the dinner, which was voted one of the best ever attended by those present.

Third day, Thursday, January 2, 1902. The Council met at 9 o'clock in Sibley Hall. The meeting of the Society was called to order at 10 o'clock, Vice-President Winchell in the chair. Professor Clarke asked for a statement from the secretary concerning the relation of the Society to Section E of the American Association, especially in regard to next winter's meeting in Washington.

The following papers were read:

Use of the terms Linden and Clifton Limestones in Tennessee Geology: Aug. F. Foerste, Dayton, Ohio.

The Lower Helderberg was named in Tennessee from its exposure at Linden, where it is but 12 feet thick, while the maximum thickness is between 75 and 100 feet. Foerste questioned the advisability of naming a formation from the place of its minimum exposure. Faunal and stratigraphic characteristics were given.

Bearing of the Clinton and Osgood Formations on the Age of the Cincinnati Anticline: A. F. Foerste, Dayton, Ohio.

In continuation of former studies the author developed his interpretation of the Cincinnati anticline. The Devonian axis of the anticline was northeast and southwest, while the present axis is north and south. The Clinton strata over the central portion of the anticline are coarse limesands with wave marks and crossbedding, and beds of conglomerates. North and south of this area, the material is a fine lime-mud. The relation of these features to those formerly described was discussed.

J. M. Clarke discussed the subdivision of the Lower Helderberg of Tennessee. The fauna has a Silurian facies. I. C. White called attention to the importance of the Clinton Iron Ore bed, and its extension in Maryland and Pennsylvania. Brief remarks were also made by H. M. Ami and B. K. Emerson.

Notes on the Catalogue of Types in the Geological Department of the American Museum of Natural History: E. O. Hovey, New York.

The paper was an exposition of the great work recently completed at the Museum in the cataloguing of the large number of types and figured specimens in the Museum, and of looking up references for each specimen. Complimentary remarks were made by J. M. Clarke, H. M. Ami, and others.

The New Carboniferous Age of the Union and Riverdale formations in Nova Scotia: H. M. Ami, Ottawa, Ont.

In Colchester county lower Carboniferous beds are thrust over the newer Union and Riverdale beds, which by their fossils are known to be middle Carboniferous. In Pictou county the Lower Carboniferous rest unconformably upon the upturned Eo-Devonian, with which the Union and Riverdale beds were formerly correlated by stratigraphers. The evidence of the overthrust is, however, complete. The Union and Riverdale beds of Nova Scotia are equivalent respectively to the Mispeck and Lancaster formations of New Brunswick.

Origin of the Faunas of the Marcellus Limestones of New York: John M. Clarke, Albany, N. Y.

The Marcellus fauna is characteristically a bituminous mud fauna. Two prominent limestone beds, the Goniatite and Stafford limestones, carry, the one an upper Onondaga fauna, and the other a lower Hamilton fauna. The former makes its appearance near the meridian of Rochester, and extends eastward, rising relatively higher and higher in the bituminous shales. The other ends at the same meridian and thickens westward. The fauna of the Goniatite limestone (fauna of *Agoniatites expansus*) represents an eastward migration of the upper Onondaga fauna, which had persisted in the west, while the bituminous mud fauna had already become established in the east. The Stafford limestone fauna is a prenuncial Hamilton fauna, which persisted for a time and then was overwhelmed again. The Onondaga and Hamilton faunas appear to have come from the northwest, while the bituminous mud fauna of the typical Marcellus shales came from the southwest.

In discussion, brief remarks were made by I. C. White, A. P. Brigham and A. W. Grabau.

In the absence of the authors the following papers were read by title:

Notes on Mts. Hood and Adams and their Glaciers: H. F. REID.

Keewatin and Laurentide Ice Sheets in Minnesota: A. H. ELFTMAN.

Devonian Interval in the Ozarks: C. R. KEYES.

Devonian Fish-Fauna of Iowa: C. R. EASTMAN.

Geological Section in Northern Alaska, along the 152d Meridian: FRANK C. SCHRADER.

Notes on the Geology of Southeastern Alaska: ALFRED H. BROOKS.

Geology of the Virgilina Copper District in Virginia and North Carolina: THOMAS L. WATSON.

Cuttyhunk Island: F. P. GULLIVER.

The Mohokea caldera on Hawaii: C. H. HITCHCOCK.

A resolution of thanks to the president and trustees of the University of Rochester and to the professor of geology, the secretary of the Society, was offered by Professor Emerson, and after some remarks by Professor Coleman was unanimously adopted. After some closing remarks by the vice-president, the Society adjourned until December, 1902.

A large proportion of the fellows remained in Rochester to attend the evening reception given by President and Mrs. Rush Rhees, of the University of Rochester. The afternoon was devoted to short excursions to the Genesee gorge and other localities about Rochester, and to an inspection of the establishments of Ward's Natural Science Bureau, the Bausch and Lomb Optical Company, etc.

AMADEUS W. GRABAU.
COLUMBIA UNIVERSITY,
DEPARTMENT OF GEOLOGY.

FORESTRY IN NEW YORK STATE.

THE New York State School of Forestry, located at the New York Land Grant College, with its laboratories in the form of trained man in this department in the Adirondacks, is discovering that the difficulties which have attended so generally the promotion of pure science in our colleges and schools, during the past generation and earlier, are not necessarily evaded or lessened when the question becomes one of promotion of applied science and the utilization of scientific method directly in the promotion of the highest interests of the State and of its people.

New York was the first of the States of the Union to provide, on a suitable working scale, for the introduction of the art of forestry into this country by systematic and scientific instruction in a technical college, purely and professionally devoted to that work. It established the 'College of Forestry' as a department of the State college, Cornell University, authorized the purchase of a large tract of forested land, gave directions that the work should be done under the supervision of an expert, scientific and practically trained forester, and conferred ample authority upon the College of Forestry, its director and the university board of trustees, to establish and permanently sustain the college and its work. The primary purpose of the college was the education of professionally trained foresters. This provision was made in 1898 and was at once put into operation. Land was purchased—outside the State Reservation and thus not subject to the constitutional limitations affecting that reservation—and work promptly begun.

Hardly had this long-needed and immensely important enterprise been inaugurated by the appointment of Director Fernow, the most experienced, professionally trained man in this department in the country, and the schedule of work and study and laboratory practice determined upon than an opposition arose, on the part of interested and ignorant persons, that was as well organized and as savage as any attack upon Cornell University in its earlier days of *Sturm und Drang*. The management was accused of seeking to make the Adirondack tracts 'as barren as the top of Mount March,' of 'methods under which everything in the shape of wood, right down to shrubs, is being sold and cut,' of infringing upon the State preserve and the State Constitution. It was asserted that 'the land is being stripped as clean as ever it would be stripped by wood-pulp men, * * * cleared of everything but brush,' that one company is taking all the soft wood and another is 'taking the rest of the growth, right down to saplings'; and numberless other equally false and foolish tales reinforced the bill of complaint.

To this curious and unintelligent assault it became necessary to reply, as the newspapers had taken it seriously in many instances and a hue and cry was being raised which might very probably do much injury to the new enterprise, to the best interests of the State and to the reputation of the university and the college. Director Fernow has prepared an open letter regarding the matter from which we abstract the following:

The introduction in the United States of forestry methods in managing forest properties has been delayed by just such misconceptions, misstatements and misdirected attacks as characterize the lucubrations lately published in various newspapers regarding the doings of the College of Forestry in the Adirondacks.

THE SITUATION.

Cornell University was, by the State, invited to establish a College of Forestry, in which professional foresters were to be educated, and at the same time there was given to it, as an experiment station in charge of the College of Forestry, a tract of land in the Adirondacks, from which the lumbermen had culled the pine and spruce. On this tract it was to show how such a culled hardwood forest might be managed under forestry principles.

The College of Forestry does *not* control the State forest reserve, has not even a voice in its management, nor is it operating on any State lands, the tract at its disposal having been deeded directly from the owners to Cornell University. While it would have a perfect right to cut the timber down to saplings, it does *not* do so, for good reasons.

WHAT IS FORESTRY?

Forestry, in simplest terms, means no more nor less with reference to wood crops than agriculture means with reference to food crops. It is a business which is concerned in the production of useful material, the most important and most widely used material, next to food materials. It is, then, entirely utilitarian. It is not concerned, at least directly, with the beauty of trees or with the shelter for game, although these aspects may be incidentally looked after. Also incidentally and more prominently must the influence of a forest cover on soil and water conditions be kept in view. This latter interest is directly important to the forester himself, since he must keep his ground in satisfactory productive condition, if he expects to be successful with his crop. The forester, then, looks on the forest as a crop and that involves *reaping as well as planting*.

THE FORESTER A HARVESTER.

He is a logger as well as a sower; he uses the axe as well as the spade and dibble. He uses the axe even more than the planting tools, for under certain conditions he may, by judicious management in the cutting of the old crop, secure the new crop by the seeds falling from the old trees before he removes them.

This is the difference between the lumberman and the forester. The lumberman simply reaps nature's product, takes the best trees, the best cuts, and leaves the rest in possession of the soil for nature to do with it as it pleases, either to let it grow up to weeds and brush or to recover the soil, in due time reproducing another crop. The forester has the obligation, when he reaps, to provide *systematically* for a new crop; not the chance volunteer crop of nature, but one of economic value, of species that are most useful, in larger quantity and better form and in shorter time than nature, unaided, could or would produce.

If the College of Forestry were only logging its tract as the lumberman does, it would, indeed, be remiss in doing its duty.

If the college were only doing what is proposed to be done on certain parts of the State Forest Reserve, namely, to cull out the valuable spruce and leave the hardwoods altogether, it would still be remiss in its duty, for while, to be sure, the charge of denuding the land could not be brought, there would not be any good forestry practice in merely reducing the most valuable part of the crop and its chances of reproduction.

REPRODUCTION THE KEY-NOTE OF FORESTRY.

The forester may not harvest his crop without systematically providing for reproduction, replacing the harvested crop by a crop, if possible, superior in composition. This can be accomplished in more than one way, and the choice of method depends on many considerations which have reference not only to the condition in which the forest manager finds the forest property that he is to manage, but also to the condition of the finances which are to back him in this business of forest cropping.

Where the lumberman has culled the desirable kinds and left the inferior, or comparatively less valuable ones, in possession of the soil, as is the case in most parts of the college tract, it stands to reason that, if the former are to be reestablished, it can only be done by reducing the latter and replanting artificially those we would wish to be most prominent in our new crop. Where the desirable kinds are still present, a new crop may be reproduced from the seeds of these, gradually removing the old trees as the young crop needs light. The College of Forestry proposes to use both methods, separately and in combination, taking advantage of any volunteer growth present, and leaving the volunteer growth of young saplings of hardwoods, conifers and older seed trees where desirable, and planting in pines and spruces to fill up the natural reproduction.

FOREST PRESERVATION BY REPRODUCTION.

The operations of the college last year extended over an area of less than 500 acres, of which it is estimated about 300 need planting. Owing to the unfavorable winter, operations were delayed, so that planting ground could be made ready only to the extent of 105 acres, which were planted. The nurseries established contain now material sufficient to plant 500 acres next spring, if the means for doing this planting can be had. Burnt and waste lands have also been planted, so that some 225 acres are now planted. In fact, counting by numbers, the college has, so far, planted 100 trees for every four trees cut. These are as many as its scanty resources permitted. It is, therefore, following the main precept of forestry to reproduce the crop. The charge that it is cutting down to mere saplings is truly puerile, for, while there would be no impropriety in doing this, provided the crop were properly replaced, there is no market for such saplings. The story comes probably from the observation that small brushwood of the felled trees has been cut and bundled as an experiment, to see whether it could not be made useful.

THOROUGH UTILIZATION.

The lumberman, it is well known, cuts and utilizes only the logs, and those of the best trees and kinds, leaving a large part of the trees he has felled on the ground as *debris,* to feed the fires and prevent young growth. The forester is forced, by the mandates of his business, to utilize as much as possible not only the poor trees, but all that is in a tree; not only the logs of the best, but of the weed trees as well, and the cordwood and the brush, if he can; or else he may have to burn the brush later. Thorough utilization, instead of the wasteful one which the mere logger practices, distinguishes the forester's work. Unfortunately, there is no market for this inferior material, which a satisfactory silviculture requires to have removed. The College of Forestry is at least trying to satisfy, as far as possible, this requirement.

WHERE THE PROFITS GO.

The charge that the logging operations are carried on for the financial benefit of Cornell University is even more puerile, for, if there were any profits to be derived from the sale of the crop, the State has carefully guarded against having them applied for any other purpose than the one in hand, namely, the running of this demonstration or experiment station and the replacement of the crop. It is absolutely impossible for Cornell University to make any profits from the College Forest, since all returns are at once turned over to the State Treasurer for the purpose aforesaid. As a matter of fact, the finances of the college experiment station are not such as to make anyone who knows them envious. Much more work in planting and improvement generally would have been done if finances permitted; that is, if the State had appropriated a more liberal working fund, such as had been asked for. Any business man knows that a certain working capital is required to carry on a given business; if this is below a certain figure, the business can only be carried on in a lame way and at a disadvantage.

INSUFFICIENT FUNDS.

This is the condition of the College Forest management; it is trying with an insufficient capital to earn what is necessary to pay for the administration and the improvements, including planting. A lumberman, logging these hardwoods, would find it difficult to make a satisfactory margin; a forester, who is obliged to log with more care and to replace the crop he has cut, necessarily works under greater financial disadvantages, and, so far, it has only been possible with great economy and care of the finances to secure any margin which can be applied to the forestry work.

The wise policy for the State, if it wished this experiment in forest management properly carried on, would have been either to make provision for annual appropriations for its conduct or to provide a sufficient working fund on which to run the experiment as a business. In my last annual report I stated that the modest fund of $50,000 was asked, but only $30,000 was allowed, which would hardly suffice to carry on a logging operation. To place the experiment on a proper basis, to permit the development of means of transportation from all parts of the property, which alone would make possible the method of gradual removal and reproduction by natural means, a working capital of not less than $150,000 should be placed at the disposal of the management.

WHO ARE THE OBJECTORS?

It remains, then, to state that the College of Forestry is doing what it is set to do. It is harvesting from an area from which the valuable part has been already removed, the old, decrepit hardwood crop which is rotting and becoming less and less valuable, and is replacing it by a young, vigorous crop of better composition. It is doing this by trying to make the old crop pay for the new; that is, carrying on the experiment like a business venture.

It may be of interest to inquire whence the opposition to its procedure comes.

There are those who have used this property as a hunting ground, and naturally desire to preserve it as such for their own personal benefit. They are opposed to the change from old timber to young plantation, which only in years will again give them a hunting ground.

Again, there are those sentimentalists who consider it a sin to cut a tree, overlooking that their houses could not be built and their homes furnished without the utilization of the forest.

There are those who mistake the situation and think it is the State's Forest Reserve that is being cut over. Moreover, as they have made up their minds that forest preservation is only to be had from nonuse, the forest preservation practiced by the college, which lies in the philosophy that all life is efficiently preserved only by reproduction, does not appeal to them.

There may also be those who know only one way of treating a forest, and hence, differing as doctors do, criticise the method of artificial reproduction by planting, which the college is in part forced, in part has chosen, to follow. These recognize only the culling process, which the lumberman has practiced with the softwoods, as legitimate; and advocate even that the State practice it in the Forest Reserve on its virgin lands, and cull out the valuable spruce in order to make the reserve of financial use.

While, no doubt, the gradual removal system has some advantages, if properly applied, it means, when applied to hardwoods, which cannot be transported by water, the development of an extensive system of railroad transportation, which requires funds such as the college has not had at its disposal.

NO FEAR FOR THE PRESERVE.

The college is doing what it can do, under the circumstances surrounding the problem, on practical business lines. It was set to doing a definite, limited task. It has no control of, no voice in, no relation to, the management of the State Forest Preserve, and would not, if it had, advocate the application of its methods to the State Preserve. For the objects of the State Preserve are entirely different from those which the college tract is to serve, and hence what is proper to do on an area set aside for demonstration is by no means proper to do or directly applicable on an area set aside primarily for soil protection and recreation.

Hence no fear need be entertained that the State Preserve is in danger of being denuded through the agency of the college. On the contrary, the college hopes to influence the management of the Adirondack Preserve in the very opposite direction. It hopes that its success in reforesting burnt and waste areas will stimulate the State authorities to do likewise. This fall the college presented to the Forest, Fish and Game Commission several thousand pine and spruce seedlings, which were planted by an agent of the Commission and by interested landholders in the Catskill Reserve.

As a result of this first beginning the Forest Commission has just contracted with the College of Forestry for 420,000 conifer seedlings to be furnished from the nurseries of the College Forest and to be planted on waste areas in the Adirondack Preserve.

Dr. Fernow's explanation should suffice not only to convince the intelligent but misled reader of the shameful attack against which he protests—and which, we observe, was telegraphed from Watertown—but even to instruct the most ignorant and thoughtless, if not to silence the selfish, obstructors of a policy which has commenced none too soon its endeavor to remedy the apparently irretrievable and fatal mischief which has done so much to bring upon the State and the nation all the grievous results of deforestation. This is one of those matters of applied science which is of such overwhelming importance as to justify the nation in making any sacrifice of time and money, the State in meeting every minutest requirement of its Forester and the people in silencing promptly and effectively every unpatriotic citizen who seeks to make the highest interests of the State subservient to his own individual petty desires.

FIELD WORK OF THE ETHNOLOGICAL DIVISION OF THE AMERICAN MUSEUM OF NATURAL HISTORY IN 1901.

In the past year the principal part of the field work of the Jesup North Pacific Expedition, which was organized in 1897, has been brought to a close. Parties were in the field in the interior of British Columbia, on Vancouver Island, on Queen Charlotte Islands, and in northeastern Siberia. Mr. James Teit continued his studies and collections among the Thompson Indians and their neighbors. Mr. George Hunt was at work in northern Vancouver Island.

The principal undertaking of the expedition on the Pacific coast of America was a thorough investigation of the Haida Indians of Queen Charlotte Islands, which was intrusted to Dr. John R. Swanton. Dr. Swanton went to Queen Charlotte Islands in September, 1900, and stayed among the Haida for more than a year. His work was eminently successful. He succeeded in unravelling the intricate social organization of the tribe, and in giving, for the first time, thoroughly satisfactory explanations of the significance of totem poles. He also collected much information on the customs and beliefs of the people, and brought back an immense mass of mythology, recorded in both dialects of the native language, as well as grammatical notes sufficient to give a clear insight into its structure.

Unfortunately the interesting art of the Indians of Queen Charlotte Islands has practically disappeared. The raids of collectors such as Swan, Jacobsen, not to mention the later inroads of traders and other collectors, have been such that hardly an article of the old objects of this tribe is left. This condition hampered Dr. Swanton very considerably, in so far as it made his work of obtaining interpretations and explanations of objects impossible. Although he took with him a large number of sketches and photographs of masks, rattles and other objects of Haida provenience, it was found almost impossible to obtain explanations for any of these, because the owners and users of these objects either were dead or could not be found.

The Siberian department of the expedition was in charge of Mr. Waldemar Jochelson. The party consisted of Mr. and Mrs. Jochelson, Mr. and Mrs. Bogoras, and Mr. Alexander Axelrod. The party was accompanied by Mr. Buxton, who was in charge of the zoological work. The expedition took the field in the spring of 1900. Mr. and Mrs. Bogoras, Mr. Axelrod and Mr. Buxton returned a few weeks ago, while Mr. and Mrs. Jochelson will continue their researches until the summer of 1902.

Mr. Jochelson investigated the Koryak and Lamut. In the fall of 1901 he crossed the Stanovoi Mountains, and is at present engaged in researches among the Yukaghir, among whom he is continuing work previously undertaken by him among the western branch of this tribe. From here he is going to proceed westward, and will spend a considerable time among the Yakut. Mr. Jochelson reports that the culture of the Koryak has many features in common with the culture of the Indians of the north Pacific coast. Particularly is the mythology and folk-lore of these Siberian tribes and of the northwestern American Indians very much alike. Their arts are in some respects related to the arts of the tribes of southeastern and central Siberia, while in other respects there are strong resemblances to the Eskimo of Alaska. At the present time the natives of northeastern Siberia do not make any pottery; but Mr. Jochelson reports that remains of pottery were found in prehistoric sites. He collected very thorough information on the ethnology and physical characteristics of the tribe among whom he was working. The collection made by Mr. Jochelson among the Koryak has reached the Museum, and will be exhibited at an early date.

Mr. Waldemar Bogoras studied the Chukchee, Eskimo and Kamtchadal tribes. His previous studies among the Chukchee enabled him to make a thorough investigation of the languages of this district. He finds the Kamtchadal and Chukchee to be closely related languages. He has collected a large number of mythological and shamanistic texts, and much information of ethnological value. He reports that his collections are very extensive.

The various field parties of the Jesup North Pacific Expedition that have been at work during the last four years have accumulated information on all the important tribes between Columbia River in America and the Amur River in Asia. The work of the expedition has been planned in such a way as to cover the whole area as thoroughly as possible. Since Nelson made a thorough study of the Alaska Eskimo, and Lieutenant Emmons had accumulated a wealth of material on the Tlingit of Alaska, no work was undertaken among those two tribes. Ethnological investigations were made in the State of Washington by Livingston Farrand; in British Columbia by Franz Boas, Livingston Farrand, Roland B. Dixon, John R. Swanton, George Hunt and James Teit. This work covered the whole province, with the exception of the Athapascan tribes north and east of Chilcotin River. Archeological work in British Columbia and Washington was carried on by Harlan I. Smith. The work in Arctic Asia was described before; but, besides, investigations were made on the Amur River, where Berthold Laufer studied the Gold and the Gilyak, and where Gerard Fowke carried on archeological researches.

It would be premature to express an opinion, at the present time, in regard to the final results of a comparison of the material accumulated by the Jesup Expedition. It is, however, evident that the material collected proves early cultural relations between the tribes of northeastern Asia and northwestern America.

The results of the expedition are being published as rapidly as possible, in the form of monographic descriptions. Up to the present time the following have been published:

'Facial Paintings of the Indians of Northern British Columbia': FRANZ BOAS.

'The Mythology of the Bella Coola Indians': FRANZ BOAS.

'The Archeology of Lytton, British Columbia': HARLAN I. SMITH.

'The Thompson Indians of British Columbia': JAMES TEIT. Edited by FRANZ BOAS.

'Basketry Designs of the Salish Indians': LIVINGSTON FARRAND.

'Archeology of the Thompson River Region': HARLAN I. SMITH.

'Traditions of the Chilcotin Indians': LIVINGSTON FARRAND.

'Cairns of British Columbia and Washington': HARLAN I. SMITH and GERARD FOWKE.

'Traditions of the Quinault Indians': LIVINGSTON FARRAND.

'Kwakiutl Texts': FRANZ BOAS and GEORGE HUNT.

'The Decorative Art of the Amur Tribes': BERTHOLD LAUFER.

The manuscript for a number of additional monographs is completed, and others are in preparation. It is estimated, at the present time, that the results of the expedition will fill eight volumes of the Museum Memoirs.

The Museum is also carrying on work in China, which has been provided for by the generosity of a friend of the institution who desires his name to be withheld. This work has been placed in charge of Dr. Berthold Laufer, who went to China in July, 1901, and is carrying on work at the present time in the southern part of that country. The first part of the collection of Dr. Laufer has arrived at the Museum, and will soon be exhibited. The studies of an expert collector and investigator in that country cannot fail to give important scientific as well as practical results. Dr. Laufer's collections from China will be supplemented by collections made by Dr. C. C. Vinton in Korea.

Work has also been carried on in North America. In the beginning of the year Dr. A. L. Kroeber collected among the western Algonquin tribes. This work was in continuation of his work among the Arapaho, and has yielded much valuable material. Dr. Kroeber's investigations were directed principally to the study of the conventionalism of the western Algonquin tribes, and to their religious ceremonies. In both these lines he collected information of great scientific interest. This investigation was provided for by the liberality of Mrs. Morris K. Jesup.

In 1901 Dr. Roland B. Dixon returned from his investigations in northern California, which were supported by the late Mr. C. P. Huntington. Later in the year Dr. Dixon was engaged in the preparation of the scientific results of his inquiry, the publication of which has been provided for by Mr. Archer M. Huntington.

During the summer two investigators were sent out to carry on work among Indian tribes. Mr. William Jones spent four months among the Sac and Fox, and brought back with him much linguistic and ethnological information. Mr. H. H. St. Clair, 2d, studied the northwestern Shoshone. His investigations were partly of a linguistic character, partly ethnological. He directed his attention to the study of the conventionalism of this tribe.

The results of the studies of North American Indians, carried on by the Museum, are in progress of publication. The first volume of these researches is devoted to the Eskimo of Hudson Bay and Baffin Bay, and is in press. The first part of the descriptions of Dr. Dixon is also nearly completed. It is expected that in the coming year the results of Dr. Dixon's and Dr. Kroeber's work may be published.

SCIENTIFIC BOOKS.

Der Gesang der Vögel, seine anatomischen und biologischen Grundlagen. Von DR. VALENTIN HÄCKER. Jena, Gustav Fischer. 1900. Gr. 8vo. Pp. viii+102. Mit 13 Abbild. im Text.

In the first chapter of this interesting brochure Dr. Häcker describes in detail the anatomical structure of the vocal apparatus in birds, which, with the accompanying illustrations, gives a fair idea of the parts concerned and their functions. Chapter II. treats of the differences in the development of the vocal muscles in different groups of birds, and especially among different groups of song birds (Oscines), as well as of the differences in the vocal apparatus in the two sexes of the same species. In the female the parts are similar to those in the male, but much more feebly developed.

Chapter III. deals with the development of the song instinct, and discusses at some length the theories of Darwin, Wallace, Groos and others, and finally presents his own views on the subject, based in part on new material. The original call-notes, from which song has been developed, he believes were originally signal or recognition sounds, and that these have become specialized according to sex and as an aid to the male in attracting the female. He recognizes four stages or phases in the development of birds' calls and songs, namely: (1) A simple, uniform call, serving as a signal and recognition note for the species, developed by natural selection; (2) varied sexual calls or pairing calls, and (3) singing and warbling, or pairing songs, serving for the mutual attraction of the sexes, and developed through natural unconscious sexual selection; (4) summer, autumn and winter songs of Palæarctic birds, expressive of the ordinary emotions of the species ('allgemeine Wirkung auf die Psyche'), and due, at least in part, to natural selection.

Chapter IV. treats of other love-making demonstrations, as the 'clapping' of the stork, the 'drumming' of woodpeckers (forms of 'instrumental music'), the 'bleating' of snipe, song-flights, dances, display of color-marking and other ornamentation, etc., and of their relation to voice and song. In this connection the evolution of courtship or love-making is also considered.

Finally there is a convenient summary of the author's evidence and conclusions, the whole forming a highly original and suggestive treatment of a very interesting subject.

J. A. A.

Catalogue of the Lepidoptera Phalænæ in the British Museum. By SIR GEORGE F. HAMPSON, Bart. Vol. III., Arctiadæ (Arctianæ) and Agaristidæ. London. 1901.

This volume of 690 pages is published in the same style as Volume II. of this series, already noted in these pages. The Arctiadæ subfamily Arctianæ comprises 946 species from the entire world, of which 83 are here first described. Fifty new generic names are proposed. The small family Agaristidæ, which are, as the author rightly observes, an outgrowth of the Noctuidæ, comprises 225 species, of which eight are here first described. Eleven new generic names are proposed in this group. The author has made some orthographical changes. *Westwoodi, whiteleyi, kinkelini, blakei,* etc., appear in a scarcely recognizable guise as *vestvoodi, vhiteleyi, cincelini, blacei,* etc. But *loewi* on page 226 escaped, doubtless by inadvertence. We think these changes scarcely advisable. The woodcuts in the text and the volume of 19 colored plates accompanying the book are up to the author's usual standard, if not slightly superior to it, and add greatly to the usefulness of the work. Owing to the author's method of selecting the types of the older genera, his refusal to recognize some of the names proposed by Jacob Hübner, and to his ideas of the extent of genera, we find the familiar names of the North American species sadly changed. We hope to become accustomed to these changes; but it emphasizes the fact that the concept of the genus is very largely a personal one. With this in view I have catalogued the specimens in the National Museum by specific names, as being the more stable. We miss the genera *Cydosia, Doa, Cerathosia, Psychomorpha, Eupseudomorpha* (*Edwardsia* Neum.), *Eudryas* and *Ciris;* but these the author doubtless regards as Noctuidæ. We hope they will not fail to find place in the succeeding volumes, as seems to have happened to the genus *Pygoctnucha* with the species *harrisii* Bd., *funerea* Grt. and *robinsonii* Bd., and to *Ptychoglene coccinea* Hy. Edw., which do not appear in either Vol. II. or III., and certainly cannot come in the Noctuidæ which will follow. Our large and handsome Arctain, *Platyprepia virginalis* Bd., has been quite omitted. Equally surprising is the absence of the familiar genus *Callimorpha* with its European and Asiatic species. If this genus belongs to the Noctuidæ by the author's classification, we think the scheme is some way at fault, for the insects are certainly Arctains in their broad characters. *Holomelina* (*Eubaphe*) *immaculata* Reak. has escaped notice, doubtless owing to Kirby's erroneous reference of it to the genus *Eudule* (Geometridæ). The species *Euhalesidota otho* Barnes, *Dodia albertæ* Dyar and *Pseudalypia geronimo* Barnes, appeared too late in description to be included. Most of these omissions are, we presume, intentional, but some seem due rather to the method by which the work has progressed, by which one family is completed before the critical study of the next one has been begun. Thus species which have been wrongly referred by cataloguers are liable to be overlooked. On page 79 *Bertholdia braziliensis* is described as new. The name must fall before *B. soror* Dyar (*Proc. Ent. Soc. Wash.*, IV., 391, May 3, 1901), which seems unquestionably the same species. On page 267 our author places *Spilosoma congrua* Walk. as a synonym of *Diacrisia virginica* Fab. We cannot agree to this, since it has been shown that a part of Walker's types were a distinct species, *antigone* Streck., and to this his description applies. *Arctia complicata* Walk. is made a synonym of *A. quenseli* Payk. We had always supposed it to be a form of *ornata*, which occurs in the same region (British Columbia), whereas *quenseli* is an Alpine form from the Alps, Labrador, White Mts., etc. But the author has Walker's type and should know. We shall be interested to see if *quenseli* can be found again in Vancouver Island.

Condensed descriptions of the larvæ of several species are given, but in a sporadic manner. Most of the life histories published within the last few years are included, but practically all the older ones published more than ten years ago are omitted. Doubtless it would have added greatly to the author's labors to have made a thorough search for all larval descriptions, but surely the North American species might have been included as they have been very completely catalogued in a bulletin issued by the U. S. National Museum in 1889. We do not, of course, desire to depreciate the value of this work, which, as we have before remarked, is a great boon to working entomologists, enabling us to identify our species far more readily than ever before. For, unlike many published synopses, Hampson's tables are practicable, not containing contradictions nor hair-splitting differences. Variation within specific limits may invalidate some of the characters which he uses, but we find this a very minor objection.

Harrison G. Dyar.

GAUPP'S ANATOMY OF THE FROG.*

This is not the first time that the present work has been noticed in this journal. The other parts as they have appeared have been reviewed as follows: Parts I. and II., Science, Vol. VII., p. 463; Part III., Science, Vol., X., p. 491.

The present part deals with the viscera, the next and concluding 'Heft' is to take up the integument and sense organs. The organs are discussed in the following order: Digestive tract, respiratory organs, thyroid gland, derivations of the pharyngeal region, urogenital organs, cloaca, and the cœlomic cavities. As with the portions of the work already published it is impossible with this to analyze the facts presented and to point out the features which are novel. Attention, however, must be called to the broadly morphological aspects of the work. Dr. Gaupp has given us not only the anatomy of the adult frog but has emphasized the bearings of the various structures. Thus at the beginning we have an account of the developmental history of the head-gut region without which the account of the derivatives of the branchial region would lose much of its interest. In the same way the urogenital structures are introduced by a longer account of their history. Then there is a valuable summary of what is known concerning hermaphroditism in the frogs. The illustrations throughout illustrate the frequent use of the

*A. Ecker's und R. Weidersheim's 'Anatomie des Frosches auf Grund eigener Untersuchungen durchaus neu bearbeitet,' von Dr. Ernst Gaupp. Dritte Abtheilung, erstes Hälfte. Lehre von den Eingeweiden. Braunschweig, Fr. Vieweg und Sohn. Pp. 438. 95 figures. Mk. 15.

color making them more readily intelligible, and the German is everywhere easy of comprehension.

In general terms we can say of this part, as of those which have previously appeared, that it maintains the highest standard of descriptive anatomical work, and when the treatise is completed we shall have in accessible form details of the structure of the frog only exceeded in anatomical literature by those relating to man. One can only wonder how a man, turning out so much research in other lines, can find time to produce such a monumental work as this. Not only has practically all of the existing literature been analyzed (the list of papers relating to the viscera includes 877 titles, some of course duplicate), but every point has been, as the title page says, 'neu bearbitet.' It is not possible to hope for a translation of such an extensive work, but the original must have a place in every biological laboratory in the country.

J. S. KINGSLEY.

A Laboratory Guide to the Study of Qualitative Analysis. By E. H. S. BAILEY, Ph.D., Professor of Chemistry, and HAMILTON P. CADY, A.B., Assistant Professor of Chemistry in the University of Kansas. Fourth edition. Philadelphia, P. Blakiston's Son & Co. 1901.

In the preface to this edition the authors say, "At the present time there seems to be an opportunity to broaden the methods of instruction in qualitative analytical chemistry, and to teach not only the facts and the mechanical methods of carrying out the various operations of analysis, but also to render them more intelligible and interesting to the student by a proper application of the theory of electrolytic dissociation and of the mass law. * * * The aim of the authors has been to produce a book which would enable the careful student to successfully carry on the work without the constant assistance of the instructor."

Several of the current manuals in their latest editions open with an introduction pointing out the significance of these theories for analysis, and in some the dissociation of the text has begun, as evinced by the furtive appearance of ions here and there throughout their pages.

The present authors are thorough; their introduction of twenty pages explains the theory of dissociation and the mass law, and the entire book is written in terms of ions; for example, "Antimony forms the positive antimonous Sb^{+++} ion, and the negative antimonite SbO_3^{---}, this antimonite, SbS_3^{---}, orthoantimonate, SbO_4 , this antimonate SbS_4^{---}, and antimonyl tartrate, $SbOC_4H_4O_6^{-}$ ions." Instead of acid or metal groups, we find groups of anions and cations.

The serious question is—are the operations of qualitative analysis rendered more intelligible to the student by this method? It seems to the reviewer that they are made more intelligible to an advanced student, but less intelligible to a beginner; but the authors intend this book for beginners.

For example the application of the phenomena of hydrolysis of salts of weak acids to the reactions occurring in the precipitation of basic salts is doubtless a help to a riper student. Again, while the following explanation of another reaction might be clear to an older student, might it not confuse a beginner? "If to a solution containing magnesium as ion, a solution containing hydroxyl ions in considerable concentration be added, a precipitate of magnesium hydroxid $Mg(OH)_2$, is produced. Ammonium hydroxid is a much weaker base than magnesium hydroxid, and consequently if an ammonium salt, such as ammonium chlorid, be added to a solution containing magnesium hydroxid, the hydroxyl ions from the latter will combine with the ammonium ions to form the slightly dissociated ammonium hydroxid, thereby decreasing the amount of the magnesium hydroxid in solution. Therefore the precipitate of magnesium hydroxid is readily dissolved on the addition of ammonium salts."

In connection with the clause quoted, it may be noted that in the separation of the groups Al, Cr, Fe—Co, Ni, Mn, Zn—Ba, Sr, Ca—Mg, the authors give directions with each group to add ammonium chloride if it is not already present, but give no reason for the use of this reagent, excepting the one statement in separating Ba, Sr, Ca—from Mg, that 'advantage is taken of the fact that magnesium carbonate is not precipitated in the presence of ammonium salts and ammonium hydroxid.' Surely the common explanation of these group separations—the successive breaking down ammonium double-salts in order of their instability by the reagents ammonia, ammonium sulphide, ammonium carbonate and disodium phosphate—is better than no explanation. It may be objected that recent research has disproved, or at least rendered improbable, the existence in solutions of ions indicating ammonium double-salts. At all events, an explanation on the lines of the above quotation regarding magnesium ion might be given.

In brief, this book can be cordially recommended to those students who are trained from the start by lectures based on Ostwald's 'Grundlinien der anorganischen Chemie,' and are taught to look at chemical phenomena chiefly in the light afforded by the dissociation theory.

E. Renouf.

Laboratory Companion for Use with Thurston's Inorganic Chemistry. By W. A. Thurston, F.R.S., Lecturer on Chemistry in Clifton College, London, Edward Arnold. 1901. Pp. 110.

The author says in his preface that this little book is a reprint of most of the experiments in Part 1 of his 'Inorganic Chemistry' and is to be used only as a laboratory companion. It is intended to be used before the study of qualitative analysis is commenced, 'and may replace such work altogether in the

Evidently it is impossible to criticise this case of those who leave school at an early age.' book without a knowledge of the text-book which it accompanies. It is very different from American laboratory manuals. The author holds it 'most important that the connection between physics and chemistry should be insisted on from the earliest stages.' The first thirty-nine experiments are purely physical with exception of one on the hardness of water, which explains permanent and temporary hardness, and gives methods for determining the hardness of water; and this before a single experiment on chemical change has been made.

The experiments given in the remainder of the book are of more chemical nature, and are interesting, but seem to laek logical sequence; it is to be supposed, however, that this seeming fault would disappear if the book was used in connection with the author's lectures, and that we have in the book those experiments which he considers to be of particular theoretic or practical interest to young students. However, the book cannot be recommended as a manual in connection with the text-books in actual use in this country.

E. Renouf.

Chemical Lecture Experiments. By Francis Gano Benedict, Ph.D., Instructor in Chemistry in Wesleyan University. New York, The Macmillan Company. 1901.

This book of 435 pages contains brief, clear instructions for performing a great number of lecture experiments. The instructor who has little apparatus at his disposal and turns to Newth or Heumann for help in illustrating his lecture often finds it impossible to show the experiments described, for lack of apparatus. The author has rigorously excluded all costly apparatus, and has yet succeeded in giving so many brilliant and instructive experiments as practically to cover the whole course. This renders his book invaluable to instructors in schools and in the smaller colleges. But this is not all; any lecturer who glances through the book will find much that is new and striking. Especially is this true of the experiments on metals, which have received such scant attention in the earlier books. The reviewer has Dr. Benedict's book in use and finds it a valuable supplement to Newth and Heumann.

Edward Renouf.

GENERAL.

'The Fauna and Geography of the Maldive and Laccadive Archipelagoes, being the account of the work carried on and of the collections made by the expedition during the years 1899 and 1900,' is now in course of publication in 'Cambridge at the University Press.' Part I. of the first volume appeared several months ago, and Part II., it is announced, 'will be published on April 15, 1902.' The work is edited by 'J. Stanley Gardiner, M.A., fellow of Gonville and Caius College and Balfour student of the University of Cambridge.' The part issued contains, besides the introduction, excellent reports on the physiography of the archipelagoes in question and on the Hymenoptera, Land Crustaceans and Nemerteans. The work will be more fully noticed when completed.

SCIENTIFIC JOURNALS AND ARTICLES.

THE *Journal of Comparative Neurology* for December. 1. Shinkishi Hatai, 'On the Mitosis in the Nerve Cells of the Cerebellar Cortex of Fœtal Cats,' shows: (1) The germinal cells of the nervous system of the fœtal cat present a modified form of the heterotypical mitosis of Flemming, (2) the number of the chromosomes represented by internodes of segmental filaments is 16, (3) all of the 'Halospindel' and a part of the central spindle are derived from the nucleolar substance, the central spindle containing the linin in great abundance. 2. Alice Hamilton, M.D., 'The Division of Differentiated Cells in the Central Nervous system of the White Rat.' The number and position of the dividing cells in later developmental stages (at and near birth) are described and compared with the results of other workers. Regarding the nature of the dividing cells, the author concludes: (1) There are at least two kinds of dividing cells in the central nervous system of the white rat, one small the other large, (2) neuroglia cells are derived from the small cells, nerve cells from the large ones, (3) dividing cells found in the gray matter and fiber tracts of the brain and cord are not indifferent cells, but are partly differentiated and it is possible to tell which are to become neuroglia cells and which nerve cells, (4) mitotic figures are occasionally found in multipolar nerve cells and in spongioblasts. 3. C. H. Turner, 'The Mushroom Bodies of the Crayfish and their Histological Environment.' A description of the supra-œsophageal ganglion of the crayfish, in the course of which it is shown that the mushroom bodies and the central bodies of the brains of crayfish and insects are homologous structures and that both of these organs are also present in worms. The first article is illustrated by one plate, the second by two, and the third by four.

PLANS have been made for a new engineering quarterly, which is to be known as the *Harvard Engineering Journal.* The first number, which will appear on March 1, will consist largely of a description of Pierce Hall, the new enginering building, and of the engineering department.

THE two journals devoted to geographical education that have hitherto existed in this country have been merged, and will appear, beginning with January, as the *Journal of Geography,* devoted to the advancement of geographical education. The new journal will be edited by Richard E. Dodge, professor of geography, Teachers College, Columbia University, and hitherto editor of the *Journal of School Geography;* Edward M. Lehnerts, professor of geography, State Normal School, Winona, Minn., and formerly editor of the *Bulletin* of the American Bureau of Geography, and Dr. J. Paul Goode, instructor in geography, University of Pennsylvania, Philadelphia, Pa. The *Journal of Geography* will appear ten times a year, with 480 pages to the volume. It will be 7 x 10 inches in size, and extensively illustrated. The editors will be aided by a large number of associate editors, representing different phases of geography. The journal will be published by the J. L. Hammett Co., Boston and New York, and will be printed at Lancaster, Pa.

SOCIETIES AND ACADEMIES.

AMERICAN MATHEMATICAL SOCIETY.

THE eighth annual meeting of the American Mathematical Society was held at Columbia University on Friday and Saturday, December 27–28, 1901. A single day's sessions no longer suffice for the extensive programs of the Society's more prominent meetings. In providing for a two-day meeting it was hoped to gain ample time for the presentation of papers, but the long program completely filled the four sessions. Fifty-nine members were in attendance, a number exceeding all previous records. An enjoyable social feature of the meeting was the dinner at the Hotel Marlborough on Friday evening attended by fifty persons, including representatives of the American Physical Society, which was in session on Friday.

At the annual election, on Saturday morning, the following officers and members of the Council were chosen: Vice-Presidents, Maxime Bôcher, Frank Morley; Secretary, F. N. Cole; Treasurer, W. S. Dennett; Librarian, D. E. Smith; Committee of Publication, F. N. Cole, Alexander Ziwet, Frank Morley; Members of the Council to serve until December, 1904, Pomeroy Ladue, G. A. Miller, P. F. Smith, E. B. Van Vleck. The President of the Society, Professor E. H. Moore, holds office for a term of two years expiring at the annual meeting of 1902. Resolutions were adopted by the Council expressing appreciation of the services of the retiring Librarian, Professor Pomeroy Ladue, who has held that office since 1895.

The following persons were elected to membership in the Society: R. E. Allardice, Stanford University; Miss Grace Andrews, Columbia University; S. E. Brasefield, Michigan Agricultural College; W. E. Brooke, University of Minnesota; T. C. Esty, University of Rochester; L. L. Jackson, State Normal School, Brockport, N. Y. Seven applications for membership were received and laid over, under the by-laws, for action at the February meeting.

Reports were received from the secretary, treasurer and librarian. These reports will appear in the Society's Annual Register now in preparation. The Society has now 378 members, a net gain of 21 over last year. There are 17 life members. The total attendance of members at the meetings of 1901 was 230, the number of papers read 140, in both cases a large increase over previous years. The Treasurer's report shows a balance of over two thousand dollars. The *Transactions* has just initiated its third annual volume; the *Bulletin* has been issued since 1891. An especially important event of the past year was the deposit of the library of the Society in the charge of Columbia University, through whose generous action the books will now become available for the use of the members. A catalogue will soon be issued and steps will be taken to extend and complete the collection.

Following is a list of the papers read at the annual meeting. It may be added that the Chicago Section of the Society issued a preliminary program of nineteen papers for its meeting at Evanston, Ill., on January 2–3, 1902.

(1) 'Further types of unicursal sextic scrolls,' by Virgil Snyder.

(2) 'On the nature and use of the functions employed in the recognition of quadratic residues,' by Emory McClintock.

(3) 'A theorem concerning the method of least squares,' by Harold Jacoby.

(4) 'The theory of maxima and minima in n variables,' by Harold Jacoby.

(5) 'Recent researches in the theory of screws,' by Sir R. S. Ball.

(6) 'On surfaces whose geodetic lines are represented by curves of the second degree when represented conformably upon the plane,' by H. F. Stecker.

(7) 'A recent method for treating the intersection of plane curves,' by C. A. Scott.

(8) 'Two principles in the theory of multiple forms,' by Edward Kasner.

(9) 'On the invariants of a homogeneous quadratic differential equation of the second order,' by D. R. Curtiss.

(10) 'Some applications of the theory of assemblages,' by Arnold Emch.

(11) 'On a method for constructing all the groups of order p^m,' by G. A. Miller.

(12) 'Note on the transformation of a group into its canonical form,' by S. E. Slocum.

(13) 'On the characteristics of differential equations,' by E. R. Hedrick.

(14) 'On the circuits of plane curves,' by C. A. Scott.

(15) 'On the plane quartic curve,' by F. Morley and A. B. Coble.

(16) 'On the real solutions of systems of two homogeneous linear differential equations of the first order,' by Maxime Bôcher.

(17) 'The projective axioms of geometry,' by E. H. Moore.

(18) 'Remarks on the sufficient conditions in the calculus of variations,' by E. R. Hedrick.

(19) 'Note on isotropic congruences,' by L. P. Eisenhart.

(20) 'Lines of length zero on surfaces,' by L. P. Eisenhart.

(21) 'Concerning the class of a group of order p^m that contains an operator of order p^{m-2} or p^{m-3}, p being a prime,' by W. B. Fite.

(22) 'A characteristic property of the parabolic curve of nth order,' by Edward Kasner.

(23) 'On the content or measure of assemblages of points,' by Carl Gunderson.

(24) 'On the holomorphisms of a group,' by J. W. Young.

(25) 'On the resolution of orthogonal transformations,' by P. F. Smith.

(26) 'Proof that the group of an irreducible linear differential equation is transitive,' by Saul Epsteen.

(27) 'On the uniform convergence of Fourier's series,' by W. B. Ford.

The next meeting of the Society will be held in New York City on February 22. The Chicago Section will meet at the University of Chicago in April.

F. N. COLE,
Secretary.

COLUMBIA UNIVERSITY.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of the Academy of Science of St. Louis on the evening of December 16, the Nominating Committee reported a list of candidates for the offices of the Academy for the year 1902.

A paper by K. K. MacKenzie and B. F. Bush, entitled, 'The Lespedezas of Missouri,' was presented by title.

Professor F. L. Solden delivered an address on the advance made in education during the nineteenth century, stating that the most characteristic feature of the century's progress lay in the epoch of expansion and organization which it marked. The influence of Pestalozzi, Froebel, Horace Mann, William T. Harris and other distinguished educators was traced, the marked change in opinion concerning the commercial value of education brought out by the Centennial exposition of 1876 was indicated, and the establishment of a true university grade in this country with the opening of the Johns Hopkins University, the year following, was commented on.

Professor F. E. Nipher stated that he had continued his experiments on the production of ether disturbances by explosions, and by the motion of masses of matter. He had apparently succeeded in eliminating the effects of the shock of the air-wave upon the magnet needle. The needle is adjusted to a condition approaching maximum sensitiveness. There is no iron about the apparatus, except what is contained in the needle and in the compensating magnets. The latter are clamped in place so that the structure on which they are mounted may be pounded by a mallet without disturbing the needle. Rowland effects due to convection of electrified particles have also been eliminated. There remains a marked deflection of the needle, seeming to indicate that an ether distortion or wave originates in a sharp or violent explosion. This result is so amazing that it is announced with the statement that the whole subject is yet under the most searching examination. The coherer and the receiver of the telephone are to be used in two wholly different plans of experiment, in one of which the effects along the entire track of a leaden bullet are to be summed up in an alternating current. The results which seem to have been reached are in entire harmony with the well-known experiment of Michelson and Morley, who found that the ether within the building in which they worked was being carried along with the building and with the earth in its orbital motion.

WILLIAM TRELEASE,
Recording Secretary.

NORTH CAROLINA SECTION OF THE AMERICAN CHEMICAL SOCIETY.

THE fall meeting of the North Carolina Section was held on Saturday, November 23, 1901, at 11 a. m., in the office of the State Chemist, Agricultural Building, Raleigh, with presiding officer, W. A. Withers, in the chair. Eighteen (18) members and visitors participated in the meeting.

After the reading and adoption of the minutes of the previous meeting and the transaction of some minor miscellaneous business, the following program was presented and discussed:

'Notes on Instruction in Dyeing': G. S. Fraps.

The author gave a brief account of methods used and results obtained, in teaching dyeing at the North Carolina College of Agriculture and Mechanic Arts. Scrap books, which had been prepared by students, containing dyed samples and tests made on them were exhibited, to show the methods pursued.

'Systematic Acid Analysis': A. S. Wheeler.

The plan suggested by Abegg and Herz (*Zeit. für Anorg. Chem.*, 23, 236) is being tried with certain modifications with his classes in qualitative analysis in the University of North Carolina with considerable success. He finds it to be the nearest approach to a separation similar to that used with bases that he has cognizance of.

'Recent Work on the Phthaleins': Charles E. Brewer.

This was a review of the several articles that have recently appeared. The first of these was by Orndorff and Brewer on the constitution of gallein. The other three articles, in the current volume of the *Berichte* contributed by Liebermann, Thiele and Jaeger and Feuerstein and Dutoit, were on dioxyfluorescein or oxyhydroquinone phthalein. In every case the view that the phthaleins react as tautomeric compounds was sustained. All the contributors agree that those derivatives which have color should have given the quinoid structure, while those which are colorless are properly represented by the lactoid structure. A number of new compounds belonging to each of these two classes were reported.

'A Constant High-Temperature Bath': Charles Baskerville.

An ordinary enameled iron water-bath is made use of, surrounded by asbestos with a copper cover and a second asbestos top projecting in the bath and a wrought-iron float constructed to hold crucibles of various sizes. The liquid of the bath is composed of a mixture of the more fusible alloys. A specially constructed thermostat, made of very infusible glass, controls the flame of a large lamp. A glass tube, open at the bottom, penetrates the dual cover and is placed within one of the crucible receptacles. A mercury thermometer under 20 degrees atmospheric pressure is used.

'New Apparatus: (1) Soil Digestion Bath and (2) A Modified Condensing Bulb Tube for Nitrogen Determinations': C. B. Williams.

Drawings of these two pieces of apparatus, designed for use in the Chemical Laboratory of the North Carolina Department of Agriculture, were submitted; also, a description was read. Mr. Williams stated that these two pieces of apparatus had proved very helpful, both in point of economy of time and reliability.

'Nitrification of Ammonium Sulphate and Cotton-Seed Meal': W. A. Withers and G. S. Fraps.

The conclusions drawn by the authors from their pot experiments on nitrification are:

(*a*) Ammonium sulphate in some cases hinders nitrification.

(*b*) In nitrification of ammonium sulphate, sulphuric acid is produced and hinders the process unless neutralized.

(*c*) Soils differ in their action, depending upon the kinds of bacteria present.

(*d*) The relative number of organisms in the soil capable of nitrifying ammonium sulphate may be increased by continued addition of the substance and lime if such germs were originally present.

(*e*) Calcium carbonate is very helpful in nitrification.

Charles Burgess Williams,
Secretary.

THE SECTION OF GEOLOGY AND MINERALOGY OF THE NEW YORK ACADEMY OF SCIENCES.

The Section met December 16, at 8:15 p. m.

Mr. D. W. Johnson gave a paper on 'Notes on the Geology of the Saline Basins of Central New Mexico.' He said that in the Antonio Sandoval Grant, near the center of the Territory of New Mexico, are noted saline deposits which have served as important sources of a very pure salt in past years. The character of these basins was discussed in some detail, and points concerning their historical interest briefly touched upon. The general geology of the central portion of the Territory was then briefly reviewed, while the local geology of the Antonio Sandoval Grant was presented more in detail. It was shown that the saline lakes occur in the Red Beds of Jura-triassic or Permian age. These beds are separable, on lithological grounds, into three divisions, designated as the Red Series, the Chocolate Series, and the Vermillion Series. Lenticular deposits of salt and gypsum are frequently found at the top of the lower or Red Series, and evidence was produced to show that the Saline Basins under consideration occur at this horizon. The facts were noted that Triassic types have been described from some part of the Red Beds (presumably the upper), while a characteristic Permian fauna has been recently found near the base of the Red Series. In view of these facts, and since no horizon of marked transition other than the salt and gypsum deposits occurs, it was suggested that these deposits might possibly mark the boundary line between the Jura-triassic and Permian in central New Mexico.

Dr. D. S. Martin presented a paper entitled 'Some Geological Notes on the Neighborhood of Buffalo, N. Y., made in the Summer of 1901.' Dr. Martin did not claim any special novelty for the data presented, but judged that they might be of interest to any members not acquainted with that region. Dr. Martin first outlined roughly the distribution of the series from the Medina to the Corniferous Limestone, and then mentioned in detail certain special features. He particularly noted certain joint seams in the Niagara Limestone near Lockport, N. Y., which have been much eroded and decomposed, and which are now filled with a dark brown claylike material, containing numbers of half decayed modern land shells, such as *Helix albolabris*. He then described the series of rocks exposed in the quarries found on North Main street, Buffalo, which are the source of the famous *Eurypterus* specimens. This series extends from the Corniferous Limestone to the Saline series and is divisible into five members, known as the Corniferous Limestone, the Blue Limestone, the Bulkhead Rock, the Water Limestone, and the Salina. Dr. Martin particularly emphasized the contact between the Bullhead Rock and the overlying Blue Limestone, and noted the occurrence of a sandstone dike extending to the top of the Bullhead series.

Mr. A. J. Queneau, in a paper entitled 'The Grain of Igneous Rocks,' said that a general observation might be made in regard to intrusive dikes. Near the margin the rock is dense, often glassy without any appreciable grain, whereas the grain begins to grow coarse according to some definite law, progressively as the distance from the wall increases. The present paper is based on the study of the laws governing such increase. It appears that the loss of heat is of paramount importance.* The problem taken up is very analogous to the one presented by the cooling of a slab of finite thickness and of great length and depth with respect to the first dimension, viz., the thickness. The method followed rests on the *Théorie de la Chaleur* of Fourier, and on the general theory of cooling by Professor R. S. Woodward.† The following laws have been deducted: (1) The zone of varying grain will vary indirectly as the initial temperature. From this follows that (*a*) Platonic rocks very deeply seated will not present a zone of varying grain to any extent. (*b*) Rocks which come to rest at a temperature nearing their consolidation point will present a wide zone of varying grain. (2) The time of cooling, other conditions being the same, varies as the square of the thickness of the dike.‡ From this last law it is assumed that the size of the crystals vary as the square of their distances from the nearest margin; then the square root of their area, which can be measured, varies directly as the distances from the margin. Thus we have a simple law of easy application.

RICHARD E. DODGE,
Secretary pro tem.

BIOLOGICAL SOCIETY OF WASHINGTON.

THE 345th meeting was held on Saturday evening, December 14.

Mr. W. H. Holmes spoke on 'Finds of Fossil Remains and Indian Implements in a Spring at Afton, Indian Territory.' The spring was situated in a level country and the superficial strata consisted of four feet of sand overlying

* Alfred C. Lane, Geol. Surv. of Michigan, Vol. VI.

† *Annals of Mathematics*, Vol. III.

‡ Riemann, 'Partielle Differential Gleichungen.'

a gravel bed about sixteen feet in thickness. In the gravel at the bottom of the spring were found several hundred finely made flint arrowheads and spear-points, such as were used by the buffalo-hunting tribes, flakers of deer antlers, bones of recent wolf, horse, bison and elk, and teeth and fragments of bone of fossil bison, horse, mammoth and mastodon, teeth of these latter being present in considerable numbers and in an excellent state of preservation. In the gravel all about were similar fossil remains, but somewhat widely scattered. It had been learned from an old Indian chief that the arrow heads and other implements were cast into the spring as offerings, but it was difficult to account for such large numbers of fossil teeth and broken bones and their mixture with those of recent animals. It was suggested by Mr. Gilbert in the discussion which followed Mr. Holmes' paper, that possibly these teeth were offerings also, having been gathered from time to time, as they might have been washed out, and cast into the spring.

W. A. Orton described 'The Wilt Disease of the Cow Pea and its Control,' stating that the disease was caused by the clogging of the water tubes by bacteria, and that it was very prevalent among all save one of the varieties of the cow pea. This variety, known as the Iron, was resistant to the wilt bacillus as well as to the nematode, causing root-knot; that it was thus doubly resistant was an additional reason for hoping that similar cases might be found among other plants.

Theo. Gill presented a paper, in conjunction with C. H. Townsend, on 'The Largest Deep-Sea Fish,' this being the species described in Science for December 13, under the name of *Macrias amissus*.

William Palmer gave 'A Study of Two Ghosts,' explaining the manner in which spectral appearances had been caused on two occasions. In one instance the shadow of a person had been thrown on a cloud of mist by a light shining through a window of an adjacent house, and in the other a similar shadow had been cast on a passing dust cloud by an electric light. The disappearance of the mist and of the dust gave the impression of a vanishing figure.

F. A. Lucas.

SHORTER ARTICLES.

ARE HUMMING-BIRDS CYPSELOID OR CAPRIMULGOID?

In the *Proceedings* of the Zoological Society of London, for April 2, 1901, there is a most interesting paper by Professor D'Arcy Thompson 'On the Pterylosis of the Giant Humming-bird (*Patagona gigas*).' It is illustrated by some excellent figures and the description is detailed and accurate. In his concluding paragraph the writer says: "On the balance of evidence, I am inclined to think that the facts of pterylosis, so far as they go, tend to justify the association of the humming-birds with the goat-suckers and swifts, and, if anything, to bring them somewhat nearer the former than the latter of the last two." But he adds that 'the evidence is confused and the judgment far from clear.'

In the *Journal of the Linnean Society*, 1888, Dr. R. W. Shufeldt published his well-known 'Studies of the Macrochires.' He, too, had investigated the pterylography of humming-birds, goat-suckers and swifts, and he reached these conclusions: The *Caprimulgi* "have their nearest kin in the owls, and they have no special affinity with the *Cypseli*, much less with the *Trochili*. * * * The true swifts must have a group or an order created for them, as the order *Cypseli*, * * * just outside the enormous Passerine circle, but tangent to a point in its periphery opposite the swallows. * * * For the *Trochili*, I have already proposed a separate order * * * and am to-day more convinced than ever of the correctness of that proposal." On page 369 Dr. Shufeldt says further regarding humming-birds and swifts: "They differ essentially in their pteryloses and in the number of their secondaries."

I have just completed a careful examination of 23 humming-birds, representing 11 species, ranging in size from *Mellisuga humilis* to *Coeligena clemenciæ*, and 15 swifts, representing 10 different species, including *Collocalia*, *Hemiprogne*, and *Macropteryx*. I have also studied carefully the pterylography of 17 goat-suckers, representing 8 species. I have, therefore, had a considerably larger number of species at my disposal than even Dr. Shufeldt had, and it seems to me worth while to state what conclusions my studies have led me to.

No group of birds with which I am acquainted shows such remarkable uniformity in their pterylography as do the humming-birds. So far as I can see Professor Thompson's figures of *Patagona* would answer, almost without change, for any of the 11 species I have examined. The only important difference is the absence of anything like what he calls the 'lateral' tract; I have found this in none of the specimens before me. In the feathering of the occipital region, moreover, my specimens do not agree with his figure, though they answer well to his description. Even nestlings and embryos (removed from the egg before hatching) of *Mellisuga* have precisely the same pattern of pterylosis, as in all adults. The swifts are not so constant to a single pattern as the hummers, and show some considerable generic diversity, but they nevertheless possess a very characteristic type of pterylosis. I am utterly unable to agree (however much we may allow for individual diversity in the birds and the personal equation of the observer) to either Dr. Shufeldt's account, or Professor Thompson's figure, of the cypseline pterylosis. This is not the place to enter into details, but one point at least must be mentioned. The posterior cervical apterium, so conspicuous in the humming-birds, is present in every swift I have examined, and I have not seen it in any other birds. Professor Thompson failed to find it in *Collocalia* and Dr. Shufeldt says it is *never* present in the swifts!

In the feathering of the head, the humming-birds do show a slight resemblance to the goat-suckers, but this is really not so close as appears at first sight. The swifts differ from both, but some species have the feathers on the occiput few and far between, as in the hummers. It must be borne in mind, however, that the pterylosis of the head is quite variable, perhaps more so than that of any other part of the body. In the pterylosis of the neck, the swifts and humming-birds are very similar, especially on the upper side, while the goat-suckers are strikingly different. The feathering of the back shows considerable resemblance between swifts and humming-birds, for while some swifts have the femoral tracts separate, others have them more or less united with the dorsal, as they are in the humming-birds. The dorsal tract of the *Caprimulgi* is obviously different, and the femorals are always well defined and free from the dorsal. The humeral tracts in both swifts and hummers are near the dorsal, and their posterior ends tend to run into either the dorsal or the anterior end of the femorals. In the goat-suckers, the humerals are narrow and some distance from the dorsals. On the ventral side, we find the sternal tracts in the goat-suckers are more or less abruptly narrowed to form the rather long ventrals, while in the swifts and the humming-birds, the sternals pass imperceptibly into the short ventrals. As far as the number of secondaries is concerned, that is chiefly a matter of size; humming-birds have 5–7, swifts 8–11, and goat-suckers 12–14.

For these, and very similar reasons, I am led to disagree with Professor Thompson that the humming-birds are nearer to the goat-suckers than to the swifts, and I must dissent quite as strongly from Dr. Shufeldt's opinion that the pteryloses of swifts and humming-birds are 'essentially different.' To my mind, the swifts and humming-birds are pterylographically nearer each other than are grouse and guans, and almost as nearly allied as grouse and quail. I cannot see that the *Caprimulgi* have any close relationship to either.

HUBERT LYMAN CLARK.
OLIVET, MICH.,
October 30, 1901.

INJURIES TO THE EYE CAUSED BY INTENSE LIGHT.

THERE may be some general interest in the following cases of optical phenomena brought about by exposure of the eye to intense light.

Professor M., while working in a rather dark corner of his laboratory, accidentally broke a low-resistance circuit in which an electric current at a pressure of five hundred volts was flowing. The arc formed was about a foot from his eyes and appeared like a ball of fire rather more than six inches in diameter. Immediately there was a feeling that something had 'given way' in his right eye, though no pain was experienced. Shortly afterwards he noticed that a part of the retina was permanently affected, the injured portion being in the form of a square, with the center of vision in one corner. The sharp outlines of this field could be easily distinguished, and upon closing the eye, fan-shaped flashes of a violet color spread out from one corner over the injured area at equal intervals of several seconds, their recurrence being entirely involuntary. After being some time in the dark the flashes of color ceased.

There was in general an apparent lack of illumination over this part of the retina, accompanied by a loss of power to properly distinguish colors, more especially green. The outlines of objects were blurred, their dimensions also appearing to be reduced by about one quarter. Printed letters could not be recognized at more than half the distance at which they were easily read by the uninjured eye. Parallel lines seemed to converge over the injured portion. In walking and riding he noticed at a short distance ahead what seemed to be a spot a few inches in diameter and about two inches high, which he often turned his wheel aside to avoid. The injured eye was also very defective in estimating distances. The effect lasted several weeks with almost undiminished intensity, but has since been gradually disappearing.

The second case is that of Mr. R., who in May, 1900, imprudently observed for some time the partial eclipse of the sun with his eyes unprotected in any way. No effect was noticed until late in the day, when in looking over the hillside he saw apparently a flock of eight or ten red birds whose movements were very erratic. Since the birds appeared wherever he looked, he carefully examined the field of vision, and discovered that the sun had formed a crescent image on the center of the retina of the left eye. The color of the image was green with a narrow red border. The injured area seemed to be quite blind, and parallel lines diverged around it, this effect being just the opposite of the previous case. The injury is always noticeable and very annoying, especially in reading. In making observations in the physical laboratory he had to discontinue the use of his left eye, which he had been accustomed to use constantly. The effect is still noticeable after a year, though it causes much less annoyance.

A case exactly similar to this has been described, in which the injury had lasted ten years.

Frank Allen.

Cornell University.

CURRENT NOTES ON METEOROLOGY.

RAINFALL, COMMERCE AND POLITICS.

A suggestive paper by H. H. Clayton in the *Popular Science Monthly* for December, on 'The Influence of Rainfall on Commerce and Politics,' forcibly emphasizes the interest and value of the studies that may be made along the lines of human, or economic, meteorology. In pointing out that 'every severe financial panic (in the United States) has been closely associated with a protracted period of deficient rainfall,' and that 'there has been no period of protracted drought without a severe financial panic except a period, the effects of which were masked by the large disturbances attending our Civil War,' the author has clearly indicated how closely national crises are related to the changing meteorological conditions of successive years. The sequence of deficient rainfall—deficient food supply—financial panics—changes in the dominance of political parties,—is also considered. There is much in this discussion that might well occupy the attention of those who take pleasure, not only in studying the correlations of meteorological conditions and politics in the past, but who also wish to try their luck at forecasting the political changes of the future. Mr. Clayton rightly calls attention to the value of such investigations on the economic side of meteorology, and to the need of more opportunity in our universities for the study of the influences of the atmosphere upon health, upon commerce and upon politics.

This interesting paper suggests a number of other, somewhat similar, examples of the influence of weather upon political movements of greater or less importance. Among the causes of the 'Boxer' outbreak in China, which involved several nations in war, was the scarcity of rain during the preceding autumn, and the consequent impoverishment and discontent of the people. In this very Chinese war, the allies at Tientsin (July 3, 4) are reported to have been saved from total defeat by a torrential rainfall which obliged the Chinese to retire. A severe winter precipitated the outbreak of the French Revolution. The Russian saying that the Russian Generals January and February are invincible dates from the time of Napoleon's terrible retreat from Moscow, and again suggests the historical importance of a severe winter. Going back much farther, into more ancient history, we find that in the year 54 B. C., Cæsar's legions in Gaul had been scattered about in separate winter quarters, because of the scanty harvest following a drought. Under these circumstances a defeat at the hands of the enemy was natural, and actually took place.

The number of such cases might be extended almost indefinitely, but anyone who reads history with his eyes open to the controls which lie behind the military and political movements of the past will be able to collect an abundance of illustrations for himself.

ECONOMIC EFFECTS OF LAST JULY'S HEAT AND DROUGHT.

ANOTHER recent paper, by the compiler of these Notes, published in the *Bulletin of the American Geographical Society* for October, under the title, 'Some Economic Aspects of the Heat and Drought of July, 1901, in the United States,' brings out certain additional features in connection with the economic side of meteorology. Trade in the United States throughout the greater part of July showed some very marked effects of the high temperatures and of the drought. There was, on the one hand, a stimulation of retail trade in all kinds of light-weight summer clothing, and the continuance of the heat carried this sale beyond the usual time. On the other hand, there was commonly noted a depression of retail trade other than that in summer goods. The heat of the first week of July caused a practical suspension of industrial activity in many cities, thus interfering with the output along the several lines affected by the shutdowns. The drought caused a lack of pasturage in the Southwest, and this led to record-breaking shipments of cattle and hogs to market at Kansas City. Thus the market became overstocked; buyers dictated prices; the situation in hides was much complicated. Prices of cereals and of railroad stocks showed marked fluctuations throughout the hot spell, the damage to corn being the chief control in the case. Reports of rain in the corn belt sent up the prices of corn, and of the stocks of the corn-carrying railroads. Under the influence of the July drought, the number of failures in August was larger than usual. Building was interfered with, and trade in building materials was checked. Meat was in less, and fruit and vegetables were in greater, demand than usual. The demand for ice was so great that there was difficulty in chartering vessels enough in which to ship the ice from Maine.

SNOW CRYSTALS.

MR. WILSON A. BENTLEY, of Nashville, Vt., who has spent some twenty years in the critical study of snow crystals by means of micro-photography, contributes a paper under the title, 'The Story of the Snow Crystals,' to *Harper's Monthly Magazine* for December. This article does not differ essentially from one by the same writer in the *Monthly Weather Review* for May last. Since January, 1885, 800 photographs of snow crystals have been taken, and no two of them are alike. The conditions under which the different forms of crystals fall have been carefully studied, and it is stated to be possible to read the character of a storm directly from its crystals. Mr. Bentley's micro-photographs rank with any that have been obtained in Europe. Several of the most beautiful types are reproduced with the article.

WEATHER AND TETANUS.

NUMBERS of cases of tetanus have recently followed vaccination in different sections of the eastern States where there have been outbreaks of smallpox, and the blame has usually been laid upon the impurity of the vaccine matter. In at least one case, however, a study of the conditions seems to lead to another conclusion. The recent epidemic of tetanus in Camden, N. J., prompted the local Board of Health to send out a circular giving the facts collected by the Board. From this circular it appears that a bacteriological examination of the vaccine matter used in Camden showed it to be free from tetanus germs. The reason for the epidemic is found in the prevailing weather conditions, combined with carelessness on the part of persons recently vaccinated. There had been a long spell of dry weather, accompanied by high winds, which raised the dust, so that there were tetanus germs constantly present in the atmosphere. Infection resulted when the scabs had been removed, and the germs gained access to the wound.

R. DeC. Ward.

WIRELESS TELEGRAPHY.

The readers of Science may be interested in the following editorial taken from the London *Electrician* of December 20. It seems to us also that the Marconi system cannot be expected to replace submarine cables, which form at present a network which appears almost as complicated on a small map of the world as the network of railways on an ordinary map of the State of Illinois. An attempt to substitute the Marconi system for existing cables would lead to a state of affairs closely analogous to the confused din in a stock exchange where each person makes more noise than all the rest. This analogy enables one to appreciate the limitations of wireless telegraphy. In the one case we have electrical waves and in the other case sound waves spreading in all directions from each sending station; and we must remember that Marconi's receiver is far inferior to the human ear in its ability to analyze a complicated system of waves falling upon it, or, in other words, to respond selectively to certain types of waves.

W. S. Franklin.

"The current week opened with the startling announcement throughout the world that Mr. Marconi had succeeded in transmitting wireless signals across the Atlantic. By means of a kite he had contrived, at St. John's, Newfoundland, to intercept waves transmitted from Cornwall, the actual receiver being a telephone and the actual 'message' the Morse letter 'S' at intervals of five minutes, as prearranged. The sounds were very faint, though they are declared by Mr. Marconi himself to have been unmistakable. Thursday, December 12, 1901, may prove, therefore, to be a date to be remembered in the history of wireless telegraphy. Within this apparently feeble result—three very faint clicks repeated at intervals of five minutes—there is to be seen the germ of ocean wireless telegraphy, and, perhaps, telephony. It is a germ that promises to develop into abundantly fruitful maturity. It is not in the interlinking of continents divided by an ocean, but rather in the overspreading of the ocean itself with telegraphic facilities that the power and fruitfulness of this latest achievement of Mr. Marconi is to be perceived. Submarine cables already link ocean-divided continents far better than wireless telegraphy can ever do. Long ago we pointed out that the true field of wireless telegraphy is across comparatively short distances of water—that, in fact, it is really a disadvantage to wireless telegraphy to be able to take in such a wide compass as an entire ocean. Indeed, when such immense areas are covered the probabilities of confusion and clashing of signals is a thousandfold increased.

Lest any section of the public should be disposed to regard Mr. Marconi's latest experiment as foreshadowing the replacement of submarine telegraph cables by wireless apparatus, we hasten to bid them dismiss the idea. No serious competition with submarine telegraphy can ever take place on a commercial basis, at any rate until the Marconi system is evolved into something very different from what it now is. This raises the interesting but thorny question of patent rights. Others besides Mr. Marconi will have something to say on this head. We do not say that Mr. Marconi will not succeed in sending messages between this country and America; but, having regard to the uncommercial conditions under which they must be sent, it is clear that the wireless channel of transmission will be rigorously avoided by business men, to whom a guarantee of secrecy and the certainty of a recorded message are absolutely indispensable. Wireless signals in the ether can never be secret; it must always be possible to intercept them. And messages received in no more permanent form than by sounds in a telephone are too evanescent and uncertain to commend themselves to the purposes of commerce. Nor must it be overlooked that the speed of transmission by Marconi telegraphy must be extremely limited compared with the possibilities of the cable. It is, therefore, not the territory of the telegraph and cable companies that Mr. Marconi can successfully invade with his wireless telegraphy."

CLARENCE KING.

A meeting of all the scientific men engaged in the work of the U. S. Geological Survey was held in Washington on Saturday, December 28, to express their profound sorrow at the death of Mr. Clarence King, first Director of the Survey. Short but appreciative addresses, eulogistic of the life and work of Mr. King were made by Major J. W. Powell, the successor of Mr. King as director of the survey; Hon. Charles D. Walcott, the present director, and Mr. S. F. Emmons. At the request of the director Mr. Arnold Hague read the following tribute to the character and achievements of Mr. King, which was unanimously adopted by those present as an expression of their admiration of his life and their bereavement in his death:

"It is with profound sorrow that we learn of the death of Clarence King, the first director and, in a sense, the founder of the Geological Survey. In him we have lost not only a great scientific leader, but a genial and accomplished gentleman, whose personal qualities endear him to all who knew him, and whose many acts of loving kindness have left a wide circle of friends in all walks of life to mourn his untimely death.

"As organizer and, during ten years, Chief of the United States Geological Exploration of the Fortieth Parallel, he set higher standards for geological work in the United States and laid the foundations of a systematic survey of the country. He gave practical recognition to the fact that a good topographical map is the essential basis for accurate geological work.

"As first director of the present Geological Survey, he laid down the broad general lines upon which its work should be conducted and which, as followed by his able successors, have led to its present development. He established the principle that a geological survey of the United States should be distinguished among similar organizations by the prominence given to the direct application of scientific results to the development of its mineral wealth.

"In that essential quality of an investigator—scientific imagination—no one surpassed King, and his colleagues have all profited by his suggestiveness. He was never content with the study of science as he found it but always sought to raise the standard of geology as well as to apply known principles to the survey of the country.

"King first introduced microscopical petrography into American geology and, as early as his Fortieth Parallel work, he foreshadowed the application of exact physics to questions of geological dynamics. Early in the history of the present survey he established a physical laboratory. One result of this step was a paper on the 'Age of the Earth' which takes very high rank among modern scientific memoirs. Although in his last years circumstances rendered it necessary for him to devote most of his time to other occupations, he had by no means abandoned plans for geological investigation on a scale worthy of his reputation.

"In Clarence King geological science in America will miss a pioneer and a leader; the Geological Survey loses its broad-minded founder and adviser, and its older members a beloved friend."

MAP OF THE PHILIPPINES.

The *National Geographic Magazine* publishes as a supplement to its January number a map of the Philippines—5 feet 2 inches by 3 feet. The map is on the scale of 15 miles to an inch and was prepared by the U. S. Signal Office. Every town or hamlet known by the Jesuits or reported to the War Department by its many officers throughout the islands is indicated on the map. It is a compilation of everything now known about the Philippine Archipelago. Sheet I. gives the Northern Philippines and Sheet II. the Southern Philippines, as officially divided by the United States Government. A glance at the map shows how much exploration is needed in large sections. For instance, on the Island of Mindoro only a few names along the coast are given. The interior of the island is a blank. The progress made by the American Government in the islands is graphically illustrated by the red lines, indicating cables, telegraphs, and telephones, which penetrate to nearly all corners of the archipelago. Nearly seven thousand miles of wire are now strung, whereas three years ago there was not one mile in service. All the telegraph lines are owned by the government and operated by a government department—the United States Signal Corps. The stations noted as commercial stations are open to messages of a private and commercial character, while from the stations noted as military only messages of a military nature can be sent. This map is the first map of the Philippines that has been prepared by American officers. The spelling of the names is that adopted by the United States Board on Geographic Names. The War Department printed an edition of only 400. The demands of the army posts in the Philippines and in the United States exhausted nearly the entire edition, so that only a few remain for public distribution. The National Geographic Society was, however, granted the use of the plate and has printed a large edition, so that each of its members may receive a copy of what is the only up-to-date presentation of all that is now known of the geography of these islands.

THE CARNEGIE INSTITUTION.

The trustees of the institution elected by the incorporators are as follows:

The president of the United States.
The president of the United States Senate.
The speaker of the House of Representatives.
The secretary of the Smithsonian Institution.
The president of the National Academy of Sciences.
Grover Cleveland, New Jersey.
John S. Billings, New York.
William N. Frew, Pennsylvania.
Lyman J. Gage, Illinois.
Daniel C. Gilman, Maryland.
John Hay, District of Columbia.
Abram S. Hewitt, New Jersey.
Henry L. Higginson, Massachusetts.
Henry Hitchcock, Missouri.
Charles L. Hutchinson, Illinois.
William Lindsay, Kentucky.
Seth Low, New York.
Wayne MacVeagh, Pennsylvania.
D. O. Mills, California.
S. Weir Mitchell, Pennsylvania.
W. W. Morrow, California.
Elihu Root, New York.
John G. Spooner, Wisconsin.
Andrew D. White, New York.
Edward D. White, Louisiana.
Charles D. Walcott, District of Columbia.
Carroll D. Wright, District of Columbia.

The official statement of the plans of the institution is as follows:

"It is proposed to found in the city of Washington, in the spirit of Washington, an institution which, with the cooperation of institutions now or hereafter established, there or elsewhere, shall, in the broadest and most liberal manner, encourage investigation, research and discovery, encourage the application of knowledge to the improvement of mankind; provide such buildings, laboratories, books and apparatus as may be needed, and afford instruction of an advanced character to students whenever and wherever found, inside or outside of schools, properly qualified to profit thereby. Among its aims are these:

"1. To increase the efficiency of the universities and other institutions of learning throughout the country, by utilizing and adding to their existing facilities, and by aiding teachers in the various institutions for experimental and other work, in these institutions as far as may be advisable.

"2. To discover the exceptional man in every department of study, whenever and wherever found, and enable him by financial aid to make the work for which he seems specially designed, his life work.

"3. To promote original research, paying great attention thereto, as being one of the chief purposes of this institution.

"4. To increase facilities for higher education.

"5. To enable such students as may find Washington the best point for their special studies to avail themselves of such advantages as may be open to them in the museums, libraries, laboratories, observatory, meteorological, piscicultural and forestry schools and kindred institutions of the several departments of the government.

"6. To insure the prompt publication and distribution of the results of scientific investigation, a field considered to be highly important.

"These and kindred objects may be attained by providing the necessary apparatus, by employing able teachers from various institutions in Washington and elsewhere, and by enabling men fitted for special work to devote themselves to it, through salaried fellowships or scholarships, or through salaries, with or without pensions in old age, or through aid in other forms to such men as continue their special work at seats of learning throughout the world."

The meeting for organization of the board of trustees and the election of officers has been called for January 29, at the office of the Secretary of State in Washington.

SCIENTIFIC NOTES AND NEWS.

PRESIDENT IRA REMSEN, of the Johns Hopkins University, has been elected president of the American Chemical Society.

PROFESSOR H. W. CONN, of Wesleyan University, has been elected president of the American Society of Bacteriologists.

THE Society for Plant Morphology and Physiology held a successful meeting at Columbia University on December 31, 1901, and January 1, 1902, of which a full account will soon appear in SCIENCE. Officers for the ensuing year were elected as follows: *President,* V. M. Spalding, University of Michigan; *Vice-President,* Byron D. Halsted, Rutgers College; *Secretary-Treasurer,* W. F. Ganong, Smith College. The Society will meet next year at Washington with the other scientific societies.

AT the annual election of officers of the California Academy of Sciences, held January 6, 1902, the following were elected to serve in the various offices of the Society during the ensuing year: *President,* David Starr Jordan; *First Vice-President,* M. W. Haskell; *Second Vice-President,* H. H. Behr; *Corresponding Secretary,* J. O'B. Gunn; *Recording Secretary,* J. W. Hobson; *Treasurer,* L. H. Foote; *Librarian,* Louis Falkenau; *Director of Museum,* Leverett M. Loomis; *Trustees,* William M. Pierson, James F. Houghton, William H. Crocker, C. E. Grunsky, E. J. Molera, George C. Perkins, George W. Dickie.

CASWELL GRAVE, Ph.D. (Johns Hopkins), now instructor in zoology at the Johns Hopkins University, has been appointed director of the United States Fish Commission Station at Beaufort, N. C.

DR. J. KRIECHBAUMER, senior curator of the zoological collections at Munich, has retired.

A ROYAL commission has been appointed to inquire into the question of the coal supplies of the United Kingdom. It includes among its members H. B. Dixon, M.A., professor of chemistry and metallurgy in the Owens College, Manchester; J. S. Dixon, mining engineer and coalmaster, president of the Mining Institution of Scotland, and president of the Institution of Mining Engineers of Great Britain; C. Le Neve Foster, D.Sc., B.A., F.R.S., professor of mining in the Royal College of Science, South Kensington, and lately one of his majesty's inspectors of Mines; Edward Hull, M.A., LL.D., F.R.S., lately director of the Geological Survey of Ireland; Charles Lapworth, LL.D., F.R.S., professor of geology and physiography in the Birmingham University, and J. J. H. Teall, M.A., F.R.S., president of the Geological Society of London and director of the Geological Survey of the United Kingdom.

A FUND is being raised to perpetuate the memory of the late Professor Tate, for twenty-six years professor of natural science in the Adelaide University. It is proposed to erect a memorial tablet and to establish a Tate medal for geology.

MR. C. L. A. DE NICÉVILLE died at Calcutta on December 3, of malarial fever contracted in the Terai in pursuit of his investigations as state entomologist of India, an appointment which had been created for him. He was the author of 'The Butterflies of India, Burmah, and Ceylon,' and other contributions to entomology.

The death is announced of M. Charles Maunoir, for thirty-seven years secretary of the Paris Geographical Society, and the author of annual reports on geographical discoveries.

Mr. and Mrs. Harold S. McCormick, of Chicago, have founded a memorial institute for infectious diseases to commemorate their son who died recently from scarlet fever. The endowment of the institute is said in the daily papers to be $1,000,000. Dr. Frank Billings is president of the board of trustees and Dr. Ludvig Hektoen has been appointed director of the institute.

It is reported that Secretary Long will renew his request to Congress for an appropriation of $230,000 for the purchase of land and the erection of a building for the use of the naval hydrographic service.

Mr. Andrew Carnegie has offered $25,000 for a public library building at Melrose, Mass.; $20,000 for a library building at Saratoga Springs, N. Y., and the same sum for a similar building at St. Catherine's, Ont.

Subscriptions amounting to over $105,000 were announced at the annual meeting of the New York Historical Society toward the new building, which is to be erected at Central Park West, between Seventy-sixth and Seventy-seventh Streets.

The library of the late Baron von Nordenskjöld has been purchased by the University of Hellingsfors for about $50,000.

A Reuter's telegram states that Mr. William Bruce, the leader of the Scottish Antarctic expedition, has purchased the Norwegian steam whaler *Hecla* for his forthcoming expedition. The vessel will shortly be brought over to be refitted on the Clyde, where Mr. Bruce is availing himself of the guidance of Mr. G. L. Watson, the yacht builder. The *Antarctic*, with Professor Nordenskjöld's South Polar expedition on board, left Buenos Ayres on December 20 for the Falkland Islands. The *Discovery* left Lyttleton on December 21. The leakage has been stopped, except in the fore-peak, where eight minutes' pumping daily is sufficient.

The Arctic Club held its eighth annual dinner at Hotel Marlborough, New York City, December 28, Professor William H. Brewer presiding.

At the recent Columbia meeting of the Society for Plant Morphology and Physiology, it was pointed out that the American members of the Association Internationale des Botanistes will soon be called upon to vote by ballot for two members of the general committee. It was felt that in the absence of nominations the votes would be scattering and perhaps in many cases not cast at all. No body of botanists appears to have authority to make such nominations, but it was suggested that as this Society had managed the correspondence with the former owners of the *Botanisches Centralblatt*, and later with the officers of the Association Internationale, it might not seem inappropriate for this Society to suggest such nominations. Accordingly, on this basis, the Society nominated Professors C. E. Bessey and W. F. Ganong.

The Archeological Institute of America has this year established a traveling fellowship for researches in Central America, and Mr. Alfred M. Tozzer, who was last year a graduate student at Harvard, taking Professor Putnam's research course in American Archeology and Ethnology, has been appointed to the fellowship. During the past summer Mr. Tozzer accompanied Professor Putnam to New Mexico where he was successful in a study of the language and ceremonies of the Navajo Indians. During the summer of the previous year he was engaged in similar research among the Indians of California. He is thus in many ways especially qualified for this research in Central America. Mr. Tozzer is now on his way to Yucatan for the purpose of studying the language and customs of the Mayas, preliminary to a study of the Maya hieroglyphs, and with the hope that there may possibly be some tradition which would give a clue to some of the glyphs. The Institute Committee on this fellowship consists of

Messrs C. P. Bowditch, F. W. Putnam and Franz Boas.

DR. J. B. MATTISON, of Brooklyn, has offered a prize of $400 for the best paper on the subject: 'Does the Habitual Subdermic Use of Morphine cause Organic Disease? If so, What?' The contest will be open for two years from December 1, 1901, to any physician in any language.

THE Senate Committee on Commerce has reported a bill creating a department of commerce. It makes the secretary of commerce a member of the Cabinet and transfers to the new department the following bureaus: Life Saving Service, Lighthouse Board, Lighthouse Service, Marine Hospital Service, Steamboat Inspection Service, Bureau of Navigation and United States Shipping Commissioners, Bureau of Immigration, Bureau of Statistics, the United States Coast and Geodetic Survey, the Commission of Railroads, the Census Office, the Patent Office, the Department of Labor, Commission of Fish and Fisheries and the Bureau of Foreign Commerce of the State Department. A Bureau of Manufactures and a Bureau of Mines and Mining are to be established in the new department.

THE Association for Promotion of Scientific Research by Women announces that applications should be received before March 1 for the American Woman's Table at the Zoological Station at Naples and for the Investigators' Table at the Marine Biological Laboratory at Wood's Holl. Further information may be obtained from the secretary, Miss Cornelia M. Clapp, Mount Hadley College, Mass.

THE thirty-sixth annual winter course of Sheffield Lectures in the Sheffield Scientific School of Yale University has been announced. The following are the subjects and lecturers:

January 17—'The Future of South Africa': MR. JOHN HAYS HAMMOND.

January 24—'The Mosquito Story': DR. L. O. HOWARD.

January 31—'Animal Intelligence': PROFESSOR L. B. MENDEL.

February 7—'Engineering Feats in Bridge Construction': FRANK W. SKINNER, C.E.

February 14—'Through the First Antarctic Night': DR. F. A. COOK.

February 21—'The Life History of a Lake': PROFESSOR H. E. GREGORY.

February 28—'The Water Resources of the Country, and their Importance to the Community': MR. F. H. NEWELL.

March 7—'The Wild Bird at Arm's Length; new methods in the Study and Photography of Birds': PROFESSOR F. H. HERRICK.

March 14—'Some Recent Doings in Astronomy': DR. F. L. CHASE.

March 21—'Niagara Falls, in Relation to Social and Economic Problems': PROFESSOR W. H. BREWER.

THE Harben Lectures of the Royal Institute of Public Health were given in King's College, London, on January 13, 14 and 15, by Dr. Max Gruber, professor of hygiene, and director of the hygienic institute in the University of Vienna. The subject of the lectures was the 'Anti-bodies of the Blood.'

IN the new Budget for the German Imperial Home Office, a sum of 12,000 Marks is allocated for the institution of researches on protozoa and one of 150,000 Marks for the prosecution of researches on tuberculosis and the means of preventing its spread.

A COMMITTEE has been appointed to consider the question of making the museum at Cardiff a national museum for Wales.

AT a recent meeting of the Archeological Section of the Wisconsin Natural History Society, a committee was appointed to investigate the feasibility of preserving a small group of three dome-shaped mounds located in the city of Wankesha.

THE *British Medical Journal* states that according to a custom, which is doubtless less out of place in Spain than it would be elsewhere, the Royal Academy of Medicine of Madrid recently attended in a body a solemn mass for the repose of the souls of deceased members, of Spanish physicians and surgeons whose work had reflected luster on their country, and of benefactors of the Academy.

OVER 200 persons have already enrolled for membership in the proposed American Electro-Chemical Society. The first meeting for definite organization and reading of papers and discussion will probably be held in Philadelphia about Easter. A gathering of electrochemists from all parts of the United States is assured.

At the annual meeting of the Montana State Teachers' Association, held at Missoula, Mont., during the holidays, a Montana Academy of Sciences, Arts and Letters was organized. The following officers were elected: *President,* Morton J. Elrod, Professor of Biology, University of Montana; *Vice-President,* Department of Science, B. E. Tollman, Professor of Mathematics, Montana College of Agriculture and Mechanic Arts; *Vice-President,* Department of Arts, L. S. Footh, State School of Mines; *Vice-President,* Department of Letters, H. H. Swain, president of State Normal; *Secretary-Treasurer,* W. D. Harkins, Professor of Chemistry, University of Montana; *Librarian and Custodian,* B. E. Toan, Butte High School. The location of the academy is at Missoula.

The Des Moines Geographical Exposition, held under the auspices of the Science Teachers of Iowa in connection with the meeting of the State Teachers' Association, was very successful. Its scope comprised the apparatus and appliances needful to the teaching of physical geography. Some forty models were on exhibition by Howell, Ward, Ginn and Andrews, including a series from the laboratory of Cornell College, showing methods of building models in various materials. About 1,000 lantern slides were shown from selected lists of American and British dealers, with several of the best lanterns for high schools. Besides physical wall maps of all the leading series, a large exhibit was made in this section of topographic maps from the United States Geological Survey, the Mississippi river commission, the coast survey and the surveys of several European countries. Sets of rocks and minerals suitable for high schools were shown. In the section devoted to literature the publications of the Iowa Geographic Survey were placed, together with the books and periodicals, American and foreign, most needful for the school library, or for that of the teacher. In photographs the exposition was especially rich. Hoelzel, of Vienna, sent the well-known 'Charakterbilder' and the Detroit Photographic Co., the series of typical color photographs in physiography selected by Professor Norton, of Cornell College. Other exhibitors in this section were Haynes, the U. S. Geological Survey, Stoddard and Notman and James. In meteorology an exhibit was made by the U. S. Hydrographic office and by Queen & Co. The exposition was directed by Professor W. H. Norton, of Cornell College, and Mr. A. W. Brett, of the West Des Moines High School.

The public health bulletin for last week contains reports to Surgeon General Wyman from officers of the Marine Hospital Service on the theory that the germs of malarial and yellow fevers are transmitted by the bite of the mosquito. Dr. Gorgas, chief sanitary officer at Havana, reports no cases of yellow fever deaths from that disease in the Cuban capital during the month of November, a condition not obtaining for years. This result Dr. Gorgas attributes to the system introduced last February of killing mosquitoes in the neighborhood of each point of infection, with the result that the mosquitoes in Havana this year are only about one tenth as numerous as last year.

A bill has been introduced into Congress by Mr. Hepburn calling for many changes in the Marine Hospital Service. It is proposed, says the New York *Medical Record,* to alter the name to the United States Health Service, in order to bring the title more into harmony with the work which the evoluted service is now doing. The officers of the new service will be the same as of the old, except that those in charge of the administrative departments in Washington will be called assistant surgeons-general, and the pay of the surgeon-general will be increased to equal that of the surgeon-general of the army. A consulting board is to be created to advise the surgeon-general of the new service in matters relating to public health, and this officer will also consult with delegates from the health departments of the various States and territories of the Union. Uniformity in the registration of vital statistics is provided for by the bill. It will be the duty of the surgeon-general of the new service to prepare proper forms for collecting the data, in conjunction with the State boards of health, and to compile and publish them as a part of the reports of the service. The consulting board above mentioned will consist of the surgeons-general of the army and navy, the Chief of the Bureau of Animal Industry in the Agricultural Department, and the director of the laboratory in that bureau, and five other members not regularly in government employ. The service will remain a bureau of the Treasury Department.

THE new Health Board of New York City, at its first meeting, made an important departure from precedent by creating a medical advisory board of twelve prominent physicians with Professor Charles F. Chandler, of Columbia University, at the head, with the title of consulting sanitarian. The Board is to serve without pay. Its other members are:

Dr. Edward G. Janeway, Dean of the Faculty of the University of Medicine and Bellevue Hospital Medical College, and former Commissioner of Health.

Dr. Joseph D. Bryant, Professor of Surgery, University and Bellevue Hospital Medical College, and former Commissioner of Health.

Dr. T. Mitchell Prudden, Director of the Department of Pathology, College of Physicians and Surgeons; Vice-President of the Rockefeller Institute for Medical Research.

Dr. William M. Folk, Dean of the Faculty of Medicine, Cornell Medical College.

Dr. A. Jacobi, former President of the Academy of Medicine; Professor of the diseases of children, College of Physicians and Surgeons.

Dr. John Wintres Brannan, President Board of Governors of the Minturn Hospital; President Medical Board of the hospitals of the Department of Health.

Dr. Richard H. Derby, surgeon, New York Eye and Ear Infirmary.

Dr. I. Emmet Holt, President of the Medical Board, Babies' Hospital; Secretary Board of Trustees, Rockefeller Institute for Medical Research.

Dr. Alexander Smith, Professor of the Principles and Practice of Medicine, University and Bellevue Hospital Medical College.

Dr. Francis P. Kinnicutt, Clinical Professor of Medicine, College of Physicians and Surgeons.

Dr. Henry R. Loomis, Professor of Materia Medica and Therapeutics, Cornell University Medical College.

As its medical adviser the Board selected Dr. Herman M. Biggs.

THE *Lancet* states that Professor Virchow's eightieth birthday was celebrated with much enthusiasm in Bahia, Brazil. In honor of the occasion a very numerously attended public meeting was held on October 13, the company present including the Governor of the State, the President of the Municipal Council, the German Consul and the Director of the Schools of Medicine, Jurisprudence and Engineering. The arrangements were made by the Gremio dos Internos dos Hospitaes da Bahia, an association of the savants of the hospitals, and the meeting took place in the handsomely decorated hall of the Gremio Literario. M. Pontes, the president of the association, opened the proceedings with an address, after which the Governor of the State took the chair. Professor Juliano Moreira, speaking in the double capacity of a member of the medical profession and one of the editorial staff of the *Gazeta Medica* of Bahia, gave a comprehensive review of Professor Virchow's achievements, not only as a physician and a pathologist, but also as a biologist and as a *savant* whose methods of research had influenced every branch of human knowledge. He concluded by reading aloud a Latin address to Professor Virchow written on parchment for the purpose of being sent to him. M. Paranhos, speaking in the name of the *Revista do Gremio*, gave a sketch of the vast amount of work which Professor Virchow had contrived to crowd into the space of 60 years. Addresses were also delivered by M. Oscar Freire, representing the Gremio dos Internos, and by Dr. Egas Moniz, speaking in the name of the Gremio Literario and of a number of German journals of Paraná and Rio Grande do Sul. Poems in honor of Germany and Professor Virchow were recited by the last-named gentleman and by M. Damasceno Vietra, after which the national airs of Germany and Brazil were played by the band. The October issue of the *Gazeta Medica* of Bahia, the *doyen* of the medical press of North Brazil, is entirely a "Virchow number," in which the life and work of the venerable *savant* are treated in six elaborate articles by Professor Juliano Moreira, Dr. Alfredo de Andrade, Professor Pacifico Pereira, Dr. Americo Fróes, Professor Matheus dos Santos and Dr. Afranio Peixoto. The *Revista do Gremio dos Internos dos Hospitaes* has also published a special Virchow number.

UNIVERSITY AND EDUCATIONAL NEWS.

Dr. Nicholas Murray Butler, professor of philosophy and education, and since the resignation of Dr. Seth Low acting-president of Columbia University, was elected president of the University on January 6 by unanimous vote of the trustees.

The University of Wooster, at Wooster, O., will replace the building recently destroyed by fire. Dr. D. K. Pearsons of Chicago has given $100,000 to the institution for this purpose on condition that Wooster and Wayne Counties raise $40,000 and the Synod of Ohio $100,000 by February.

Columbia University has received an anonymous gift of $100,000, and a gift of $3,000 from Mr. Adolph Lewissohn for the purchase of a complete set of German dissertations for the doctorate.

William H. Chapman, president of the Savings Bank of New London, has presented to the city, through the board of school visitors, $100,000 for the building and equipment of a manual training school for use in connection with the public school system.

Mr. John D. Rockefeller has offered to give Brown University $75,000 for the erection and furnishing of a building to be used for social and religious purposes, on condition that $25,000 be secured as an endowment fund for the building before the next commencement.

By subscriptions from the alumni, $50,000 have been collected for the new Hall of Commons at Hamilton College. It will be built during the summer.

Washington University, St. Louis, receives, by the will of Colonel George E. Leighton, $25,000, and by that of Mr. William E. Huse, $20,000. Both these gentlemen were members of the board of directors of that institution.

The 'New England Building,' at Vassar College, containing laboratories for the departments of biology, physiology and geology, was formally opened on January 8, when a reception was given there by the board of trustees. The name commemorates the fact that the building fund of $50,000 was the gift of alumnæ residing in New England.

Dr. Charles W. Dabney, president of the University of Tennessee, Knoxville, has received a proposition from eastern philanthropists to establish a summer school at the University, the school to be free for teachers from all over the South.

Dr. Herbert A. Giles, professsor of Chinese at Cambridge University, will give the first course of lectures for the new Chinese department of Columbia University.

The following appointments have been made at the University of Toronto: Dr. W. H. Piersol, instructor in biology and histology; C. M. Fraser, assistant in zoology; R. B. Thompson, class assistant in botany; Dr. S. H. Westman, laboratory assistant in histology; Dr. R. E. Hooper, Dr. J. A. Roberts, Dr. W. J. McCallum, and Dr. A. F. Adams to be class assistants in histology; M. H. Embree and E. A. McCallum, class assistants in biology.

Mr. Henry Stewart Macran, fellow of Trinity College, Dublin, has been elected professor of mental and moral philosophy in the University of Dublin in the room of Mr. Swift Paine Johnston, who has been appointed one of the assistant commissioners of the board of intermediate education.

The general board of studies of Cambridge University will during the Lent term proceed to the appointment of a Sidgwick University lecturer in moral science. It is desired that psychology should be one of the subjects on which the lecturer is prepared to lecture. The appointment will be for five years.

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 24, 1902.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION H, ANTHROPOLOGY.

THE winter meeting of Section H was held in the lecture hall of Field Columbian Museum, Chicago, on December 31, 1901, and January 1–2, 1902; Dr. J. Walter Fewkes, of the U. S. National Museum, presiding.

At the opening session, Dr. Geo. A. Dorsey was chosen press secretary. Professor Franz Boas was appointed to represent the Section on a committee to revise the schedule for measurements used in gymnasia. This committee, made up of members of various societies interested in physical education, is to report at the next meeting of the American Association for the Advancement of Physical Education.

A committee to confer with delegates from the Anthropological Society of Washington, D. C., and the American Ethnological Society, with special reference to increasing the usefulness of the *American Anthropologist,* as well as facilities for anthropological publication in general, was chosen as follows: Dorsey (chairman), Starr, Culin, Dixon, MacCurdy, Russell.

At the winter meeting in Baltimore one year ago a committee, consisting of F. W. Putnam (chairman), J. W. Powell and Geo. A. Dorsey, was appointed to 'take preliminary steps for the reception of the

International Congress of Americanists' on the occasion of its first meeting in the United States. The committee reported that it had performed the duty assigned, and respectfully requested to be discharged. The Section voted to discharge the Committee and to extend grateful appreciation for its labors. According to the circular accompanying Chairman Putnam's report, the thirteenth session of the International Congress of Americanists will be held in the halls of the American Museum of Natural History, in the City of New York, beginning at noon on Monday the 20th, and continuing until Saturday, the 25th of October, 1902.

The titles of papers presented before the Section are accompanied by brief abstracts in so far as these have been secured from the authors.

The Beginnings of Anthropology: W J McGee.

Discussion: Boas, Russell, Fewkes.

Twenty Years of Section H, Anthropology: George Grant MacCurdy.

An analysis of the work done by the Section since its organization, and a comparison of the same with that done by European societies of a similar nature. The conclusion reached is that, while American anthropologists have been working in relatively greater isolation than have European anthropologists, they are now at the threshold of a new epoch destined to be marked by vast progress in correlative and synthetic anthropology. This paper will be printed in Science.

Discussion: Newell, McGee, Starr, Peet, MacCurdy, Russell, Dorsey, Hartzell, Thompson, Boas.

The Exhibit of Hopi Ceremonies in the Field Columbian Museum: Geo. A. Dorsey.

Dr. Dorsey kindly consented to supplement his paper by an explanatory talk in the exhibition rooms on the closing day of the session. The following Hopi ceremonies as they occur at Oraibi have been reproduced on a magnificent scale for the Museum by Mr. Voth: Oöqol, Marau and Soyal Altars; Powalawu Sand Mosaic; Powamu Altar and Sand Mosaic; Katcina Initiation and Sand Mosaic; Masililantu Altar; Cho Altar and Sand Mosaic; Tcob Altar and Sand Mosaic; Balulukon Screen; Hemis Katcina Dancers; Aña Katcina Dancers. The Museum also possesses a large collection of Hopi dolls, masks and head dresses.

Discussion: Fewkes, McGee.

Some Painted Stone Slabs from the Graves of the Ruins of Walpi: Chas. L. Owen.

Mr. Owen's paper was descriptive, his hearers having also the satisfaction of seeing the objects described. The stone slabs were only recently installed.

Basketry Designs in Northern California: Roland B. Dixon.

The California Indians were confined almost exclusively to basketry for the expression of their artistic sense, and to this concentration of effort is due, in part at least, the perfection to which the art of basket-making was carried. There are several more or less clearly marked areas, each of which has its own type of basketry and basketry designs. In northern California alone there are three such type areas: (1) Northwestern (Hupa, Karok, Yurok, of Powers with perhaps the Shasta). (2) Northeastern (Klamath, Modoc, Pit River, Yana, Wintu and Maidu). (3) Pomo and perhaps neighboring stocks. In his paper the author refers only to the second and third areas. Often two or more stocks show the same designs but slightly differing one from another. As a whole, however, it appears that each stock is in possession of a body of designs peculiar to itself. The author also had something to say on the questions of origin of designs and their transmission from tribe to tribe.

Discussion: Peet, McGee, Dixon, Boas, Dorsey and Hudson who gave reasons for favoring *Poma* as against *Pomo* for the name of one of the stocks in question.

Pueblo Indian Settlements near El Paso, Texas: J. WALTER FEWKES.

A study of the social organization, officers, dances, social and other customs, and linguistics of the Tiwan Indians of Ysleta; the Piros Indians of Senecu and Socorro; the Mansos and Sumas.

Discussion: Dorsey, Starr, Kinner, Fewkes.

Variability of Anthropometric Types: FRANZ BOAS.

The variability of organisms depends upon the correlation of their elements. The variability of the whole organism may, therefore, be considered largely an expression of correlation of its constituent parts. The greater the correlation of the parts constituting an organ, or included in a measurement, the greater will be its variability. Generally it is assumed that indices are expressions of correlation. The author demonstrated that they are not necessarily so, but that regression is the only sure test of correlation. The importance of the pathological method of studying correlation is emphasized. Professor Boas made free use of the blackboard as a means of illustration.

The Somatological Investigations of the Hyde Expedition: ALES HRDLICKA.

The Hyde Expedition comprises a variety of anthropological investigations on the peoples of the southwest, the whole being carried on under the direction of Professor Frederick W. Putnam for the American Museum of Natural History, New York City. The object of the somatological work of the Hyde Expedition, of which Dr. Hrdlicka is in charge, is to carry out a systematic investigation, mainly of a physical nature, on the extinct and living peoples of that part of the United States and Mexico which had once been occupied by the Pueblos with Cliff-Dwellers, and the Toltecs, Chichimecs and Aztecs. It is hoped that these studies will establish the physical types of these peoples and show their racial relations or diversities. The region over which this research extends is bounded approximately by the 38th parallel in the north, by the Rio Grande and the foothills of the Sierra Madre in the east, the Colorado River and Pacific Ocean in the west, and the States of Mexico and Michoacan in the south. It interlaces in the south with the region, the tribes of which were examined by Professor Starr and, in the north and northwest, connects with the field of work of the Jesup Expedition under Professor Boas. Dr. Hrdlicka began the outlined investigations in 1896, on the osteological material, principally Tarasco, collected by Dr. Lumholtz. In 1898 the field work was begun by the study of the tribes of Tarahumaras, Huichols and Tepecanos in Mexico. On the second expedition, in 1899, the research was carried on among the Utes and the Navahos, and on the third trip, in 1900, the investigation comprised the Mokis, Zuñis, Rio Grande Pueblos, all the divisions of the Apaches, Mohaves and a branch of the Piutes. At this moment Dr. Hrdlicka is starting on the fourth expedition, on which probably the field work will be completed. There will be visited the Suppais and Hualapais, Yumas, Pimas, Papagos, Yaquis, Tepehuanas, Coras, Aztecs, Tarascos and several smaller tribes. The work of the expedition will probably occupy the larger part of the coming year. The expenses of this as well as those of the 1900 and 1899 expeditions are generously provided for by Mr. Frederick E. Hyde, Jr., of New York city.

Some Observations concerning the Navaho Blanket Industry: Frank Russell.

The lantern slides not arriving in time, Dr. Russell did not read his paper. He, however, very kindly authorizes the secretary to make use of the abstract. Some tendencies in the progress of the Navaho blanket industry are described. The most noticeable changes are in the kind of yarn, the quality of the work and in the designs. Styles vary in different localities so that a little experience will enable one to name the district from which a given specimen comes. Methods of cheating the trader are described and an account given of the imitation Navaho blankets now offered for sale. The author tells how to identify imitations.

The Beginnings of Lithoculture: W J McGee.

Discussion: Fewkes, Thompson, Grimes, McGee, Hudson.

Certain Forms of 'Winged-perforated' Slate Objects: Warren K. Moorehead.

Mr. Moorehead's paper was fully illustrated by means of numerous originals and drawings. He called attention to the necessity of an archeological nomenclature for the various 'unknown forms' in slate and granite which have hitherto been called 'ceremonials'—a meaningless term in the opinion of the author. The paper is purely descriptive, dealing with form, type, distribution, etc.

Discussion: Culin, Moorehead.

A Voice Tonometer: Carl E. Seashore.

An exact and ready method of determining the pitch of tones in singing is described. The apparatus is a modified form of that described by Scripture, *Yale Studies in Psychology,* IV., 135. It works on the principle of the stroboscope and furnishes a direct reading of the vibration frequency of any tone sung within the range of two octaves. The reading is accurate to the twenty-fifth of a tone. Illustrations of results are given from measurements on the manner and the accuracy of striking a tone, singing the scale, singing the chromatic scale, singing an air, the singing of two notes in unison or in parts, and the singing of the least producible difference in pitch. The last named measurement is the most important because it furnishes a unit for the study of motor processes in singing and speaking.

The Psychological Elements of Visual Space Orientation about a Horizontal Axis: Robert MacDougall.

The paper is a summary statement of the results of experimental work carried on in the Harvard Psychological Laboratory during 1900–1901. Its problem is the determination of factors—and their values—of resident and transient sensation which enters into the location, by the human subject, of points in the horizontal plane of the eyes. The experimental variations involved comprise the characteristics of visual determination in an ordinary illuminated field, of the location of a luminous point in an otherwise dark field, and of orientation in complete darkness, in the case of both binocular and monocular vision. The points of greater importance here are the characteristic positive or negative errors of displacement in the subjective plane of the horizon, and the range of the normal mean variation; the influence of the cooperation and disjunction of the two eyes in the act of vision; and the general function of eye strain in such forms of space orientation. Special conditions of body strain are taken up, and an analysis made of the typical errors introduced into the process of space orientation by interferences with the normal body-relations. Of these artificially induced conditions the chief are the rotation of the eyes about their horizontal axis, the rotation of the head about its lateral horizontal axis, and the rotation of the whole body about a similar axis. A consideration of the influence exerted by the general distribution of intensities in the visual field, and of object planes and lines of perspective upon the subjective location of points in the horizontal plane of the eyes. The paper concludes with an examination of the phenomena of coordination between eye and hand in determining the plane of the eye's horizon by the index finger, the significance of this series of determinations lying in the characteristic displacement of the located point due to changes in the fundamental axes of the head and eyes. Dr. MacDougall's paper will be printed in the Publications of Harvard Psychological Laboratory, Vol. I.

The Sherman Anthropological Collection of Holyoke, Massachusetts: George Grant MacCurdy.

Mr. Gardner M. Sherman, of Springfield, Mass., an indefatigable collector for twenty-five years, has supplemented his own finds by exchanges and judicious purchases until the collection which bears his name now numbers from 12,000 to 16,000 specimens. The material is confined almost wholly to American archeology, representing geographically twenty-one States and Territories. Massachusetts, Georgia, Illinois and Tennessee are the largest contributors. The Connecticut River valley is particularly well represented. The collection was purchased last July by the Holyoke Scientific Society, and is to be installed in the new Public Library building. It is at present in the care of Mr. J. T. Draper, head of the science department of the Holyoke High School. This paper will be published in the *American Anthropologist.*

Filial Piety in China: Paul Carus.

A study of a pair of wall pendants, ornamental mottoes designed as decorations for the sitting-rooms of the Celestials. The paper and art work are crude enough to allow the assumption that the prints must be very cheap in China, and are designed not for the rich, but for the common people. They may cost in Peking or Hong Kong not more than one or two cents apiece. Evidently they serve two purposes: First, of ornament, and, secondly, of instruction. The Chinese are a moralizing people, even more so than we: while we dislike abstract moralizing, they delight in it and do not tire of impressing upon their children the praiseworthiness of filial devotion. Filial devotion is in Chinese *hsiao;* the character consists of two symbols showing a child supporting an old man, and filial piety is supposed to be the basis of all virtue. The moral relations are regarded as mere varieties of *hsiao;* and the original significance of the word, which means chiefly the devotional attitude of a child toward his parents, includes such relations as the obedience of the subject to his ruler, of the wife to her husband, of the younger brother to his elder brother, and of any one's relations to his superiors, including especially man's relation to God. The Chinese ornament their rooms, not as we do with pictures of beauty, but with moral sayings; and the two pendants described, which unfortunately cannot be reproduced here for lack of space, are typical of the national character of the Chinese.

The Significance of the Cross: Paul Carus.

Symbols pass through three stages, the magic, the emblematic and the ornamental. The Christian cross is unique in its conception. Prehistoric crosses are the same in form, but different in interpretation. The difference in meaning is important. For the sake of distinguishing between the two, let us call the figure of intersecting lines a thwart, and reserve the word cross for its original significance, viz., a martyr instrument. The old cross, the Roman martyr instrument for capital punishment by exposure to the inclemency of the weather, Latin crux, Greek staurus, had sometimes the form of an irregular thwart, but not necessarily so. Whether or not Christ's cross was a thwart is doubtful; it is possible, however, since he is reported to have borne his cross, which obviously means the *patibulum*. Christianity adopted the thwart as the form of Christ's cross because the thwart was an old religious symbol of deep significance. Thwarts were used in all countries—Egypt, Assyria, India, among the Teutons, the Indians, etc. Their significance varies, and is frequently obliterated. By promiscuously calling all thwarts crosses, we are surprised at finding the Christian symbol universally adopted by pre-Christian religions. The fact is the reverse. Thwarts were used in different meanings by almost all the nations of the world, and then the thwart was identified with the cross to such an extent that, at present, cross has come to mean any figure of intersecting lines. How misleading this identification may be we can see in the Dakota story of the Susbeca, which is a thwart and like the Latin cross in shape, but which means dragon-fly. A missionary mistook the word in the Christian sense, so he gloried in his sermons with St. Paul in the susbeca of Christ. Translations of the New Testament and the Creed in the Dakota language, according to which Christ was crucified on a dragon-fly, are still extant. To the Dakotas the susbeca is a sacred religious symbol, and the missionary's mistake may have helped to recommend to them the Christian faith; but undoubtedly the confusion served to render more mysterious to them the mystery of the cross. The two papers by Dr. Carus were both fully illustrated, and will be published in *The Open Court*.

On Wednesday and Thursday mornings, the Section met with the American Folk-Lore Society, which, like Section H, is one of the Societies affiliated with the American Society of Naturalists.

George Grant MacCurdy,
Secretary.

THE AMERICAN CHEMICAL SOCIETY.

The annual winter meeting of the American Chemical Society, the twenty-fifth general meeting of the Society, was held in Philadelphia on the thirtieth and thirty-first of December, the assembly place being the University of Pennsylvania. The opening session was in Houston Hall at half past nine on Monday morning, when the usual felicitous words of welcome on behalf of the city, the university and the Philadelphia Section of the Society were spoken and duly responded to. The reports of the officers of the Society were read, those of the secretary and treasurer being particularly gratifying, showing large increase in membership and a considerable balance in the treasury. Including the members elected at the present meeting, the membership of the Society has passed the two thousand mark; with a very few exceptions, all the prominent chemists of the country are enrolled, and no inconsiderable number of foreigners as well. The value of the *Journal* of the Society is being more and more appreciated. Thirteen Sections of the Society are already established, and a fourteenth is now being formed on the Pacific slope.

Owing to the fact that most of the business is transacted through the Council, little came before the general meeting, but a resolution was passed memorializing the United States Government to pass a law making compulsory the use of the metric system of weights and measures in all the departments except the Land Office. As is well known, its use is now optional, but outside of the scientific departments it is little used. In the Post Office and Treasury Departments its use is particularly desirable.

The remainder of the forenoon and the next morning were devoted to the reading of papers. The time for this was unfortunately so limited that hardly more than half of those on the program could find a place, and many of these were given only in abstract. The most interesting paper was of the nature of a lecture by Dr. Charles F. Chandler, of New York, on the 'Electrochemical Industries at Niagara Falls.' This was illustrated by a copious supply of specimens of the products of these industries, a very considerable portion of which was afterward presented to the museum of the chemical department of the University of Pennsylvania. Another paper which attracted much attention was by Professor Louis Kahlenberg, of the University of Wisconsin, on 'Instantaneous Chemical Reactions, and the Theory of Electrolytic Dissociation,' with experiments. The experiments illustrated facts brought to light by Dr. Kahlenberg which seem to controvert the ordinarily accepted theory of electrolytic dissociation, and no little interest was aroused by them. A list of the papers read is appended to this report.

At the close of each morning session a bountiful lunch was provided by the university authorities, after which the time till dark was occupied by excursions to various places of interest to chemists. There is no city in the country where there are so many industries in which chemistry plays an important part, and the time was well used by the visiting chemists. Indeed there was such a superfluity of trips that the members had to be grouped in six or seven sections each afternoon. The following list of places visited gives an idea of the wealth of opportunities for the study of industrial chemistry:

Baldwin Locomotive Works.

United States Mint.

City Filtration Experiment Station.

Bergner & Engel's Brewery.

Midvale Steel Company's Works.

Barrett Manufacturing Co., Working up of Coal-tar Oils.

United States Arsenal, Special Laboratory Equipment and Testing House.

John B. Stetson Company, Manufacturers of Hats.

Dungan & Hood, Glazed Kid and Morocco Works.

C. H. Masland & Sons, Carpet Mills.

Cramp's Shipyard.

Harrison Bros. & Company, Inc., Manufacturers of Chemicals and Paints, Electrolytic Method for the Production of Sodium.

Philadelphia Navy Yard.

United Gas Improvement Co., Works, Point Breeze.

Gillinder & Sons, Glass Works.

Quaker City Dye Works.

Wetherill & Bro., White Lead.

J. Eavenson & Son, Soap Works.

Girard College.

On Monday evening the address of the retiring president, Dr. F. W. Clarke, of Washington, was delivered at the rooms of the Acorn Club. His subject was 'The Development of Chemistry.' A rapid and graphic review of the past of chemistry gave indications of the lines along which chemistry may be expected to progress in the immediate future. The speaker dwelt particularly upon the desirability of coöperation in chemical research, rather than the present plan where every chemist works in his own field independent of the work of all others. Especially in inorganic chemistry are there many problems, too large for solution by single workers, which might be successfully attacked by the coöperative efforts of a number of chemists. Dr. Clarke also called attention to the mutual benefits accruing between technical chemistry and pure chemistry, research work in each helping the other.

Immediately after the address, a reception was tendered by the Club to the members of the Society and their wives. A little later in the evening a smoker was held at the University Club where memories of German student life were renewed. On Tuesday evening the annual banquet was held at the Bingham House, the decorations and the *ménu* having a decided flavor of the laboratory. Dr. H. W. Wiley, of Washington, acted as Master of the Feast, and toasts were responded to by the mayor of the city, Theodore C. Search of the School of Industrial Art, and by several members of the Society. According to one of his colleagues, Professor Chandler had the honor of making the longest speech on record. He began in 1901 and did not close till the next year!

Dr. Ira Remsen, president of Johns Hopkins University, was elected president of the Society for the ensuing year.

A meeting of the Council of the Society was held on Tuesday afternoon, at which the resignation of Dr. Edward Hart as editor of the Society's *Journal* was regretfully accepted, and Dr. W. A. Noyes, of Rose Polytechnic Institute, was elected to succeed him.

Nearly two hundred were enrolled at the meeting, and probably not less than two hundred and fifty were present, making this the largest general meeting the Society has ever held. It was in every respect one of the most successful.

The following is a list of the papers read at the meeting:

Review of Metallography: Henry Fay.

A résumé of the recent work which has been done on alloys, especially of those using the methods of physical chemistry and the microscope.

Naturally Occurring Tellurid of Gold: Victor Lehner.

The only occurrence of gold in nature combined with another element is the tellurid. A crystallographical and chemical study of these tellurids throws much doubt upon their being anything other than a mixture of the elements.

Action of Selenic Acid on Gold: Victor Lehner.

Doubt has been cast upon the oft repeated text-book statement that gold dissolves in selenic acid. It was found that gold does dissolve with considerable readiness in concentrated selenic acid at 230°–300°, forming an auric selenate. This is the only single acid, as far as known, in which gold is soluble.

The Quantitative Blowpipe Assay of Tellurid Gold Ores: Joseph W. Richards.

Contrary to the general opinion, this assay presents no difficulty. In the muffle assay, however, if much tellurium is present, the gold 'spits' and often sinks completely into the cupel. This may be obviated by adding antimony.

A New Blowpipe Reaction for Germanium: Joseph W. Richards.

Argyrodite gives a white sublimate like molybdenum, which becomes an intense blue when heated with cobalt nitrate.

Contributions to the Chemistry of the Rare Earths of the Yttrium Group: L. M. Dennis and Benton Dales.

A review of the various methods of separation of the rare earths, and the announcement of several new ones, which promise well.

Preliminary Note on a New Separation of Thorium: F. J. Metzger.

Thorium may be separated from the other rare earths almost quantitatively by fumaric acid. This reaction seems to be connected in some way with the molecular asymmetry of the acid molecule.

Sodium: J. D. DARLING.

Description of the electrolytic method in use at the works of Harrison Bros. & Co., for the production of sodium. This method was introduced primarily for the manufacture of nitric acid. A diaphragm four inches thick, made of magnesite and Portland cement, separates the two electrolytes. On the outside of this, fused sodium nitrate is at the anode, while the inner electrolyte surrounding the kathode is sodium hydroxid. As the current passes, this soon becomes sodium oxid, and then metallic sodium is formed. A current of about six hundred amperes at seven volts is used. The supply of metallic sodium on hand in storage is now so great that the city authorities have had the operation of the process stopped, fearing accident.

The Determination of Silica: W. F. HILLEBRAND.

The results of the analyses of a set of cement samples by a large number of chemists revealed great discrepancies in the amount of silica. This is chiefly due to the fact that one evaporation is not sufficient to render the silica insoluble. Further, the silica must be heated by a blast lamp before weighing.

Electro-Chemical Industries at Niagara Falls: C. F. CHANDLER.

A review of the history and a description of the processes used, illustrated by a large number of specimens. The manufacture of sodium, aluminum and carborundum was most fully considered.

Instantaneous Chemical Reactions, and the Theory of Electrolytic Dissociation (with experiments): LOUIS KAHLENBERG.

The oleates of the metals are soluble in perfectly dry benzene, and from these solutions the anhydrous chlorids are instantly precipitated by a dry benzene solution of hydrochloric acid. These solutions in benzene are practically non-conductors of electricity, consequently electrolytic dissociation cannot be supposed to have taken place; yet the reactions appear to be exactly parallel to those in aqueous solutions, to account for which the electrolytic dissociation theory is invoked.

What are the Requirements of a Course to Train Men for Work in Industrial Chemistry? W. A. NOYES.

It cannot be generally told what line of industrial chemistry a student will follow after graduation, and there are so many different fields that it would be impossible to train a man in the special technical requirements of every industry, and there should be no attempt to do this. Students should be thoroughly grounded in the general fundamental principles and have extended practice along several different lines of practical work. The special minutiæ of any branch the student may enter will then be readily learned after graduation.

The Volumetric Estimation of Alumina, and Free and Combined Sulfuric Acid in Alums: ALFRED H. WHITE.

A method depending upon the proper choice of indicators.

Aqua Ammonia: Its Impurities and Methods of Analysis: J. D. PENNICK and D. A. MORTON.

A Method of Analyzing Oil Varnishes: PARKER C. MCILHINEY.

The Oxygen Bases: A Review: JAS. LEWIS HOWE.

An outline of the recent work of Collie, Baeyer, Kehrmann, Werner and others, on compounds in which oxygen appears to be quadrivalent, forming salts with acids, as do ammonia and its derivatives.

Electrolytic Deposition of Lead from P_2O_5 Solution: A. F. Linn.

Lead can be deposited electrolytically in a form suitable for weighing from a solution containing free phosphoric acid.

Latest Types of Formaldehyde Regenerators (with demonstration): Wm. Dreyfus.

An exhibition of the various types of apparatus with a discussion of their relative merits.

Some Pyridin Derivatives: J. Arthur Hayes.

Report of Committee on Atomic Weights: F. W. Clarke, Chairman.

Attention was called to the atomic weight determinations which have been made during 1901.

Sixteen other papers on the program were omitted from lack of time for presentation; most of these will be later published.

J. L. H.

THE ASSOCIATION OF AMERICAN ANATOMISTS.

The fifteenth session of the Association, meeting with the American Society of Naturalists and affiliated societies, was held at Chicago, Ill., December 31, 1901, to January 2, 1902. The Association met in the Hull Laboratory of Anatomy, Chicago University.

The following extracts are made from the report of the secretary for 1900–01:

There are copies of the printed proceedings on hand from the 6th to the 14th volumes, inclusive, which are available to those who request them, and are especially so for presentation to libraries. A republication of the first five proceedings under one cover is being made.

At the last report there were 125 members, 116 of whom were active and nine honorary. During the year twelve active members were elected, two died, one resigned, and three have been dropped for non-payment of dues. The present number is 131 total members, 122 active, 9 honorary.

Dr. Frederick John Brockway, assistant demonstrator of anatomy, Columbia University, New York, died April 21, and Dr. Geo. Wm. West, late professor of anatomy and physiology, medical department, National University, Washington, D. C., died July 24.

The following new members were elected:

Dr. R. R. Bensley, Asst. Prof. Anat., University of Chicago.

Dr. John L. Bremer, Harvard University.

Benson A. Cohoe, A.B., M.D., Asst. in Anat., Cornell University.

Henry H. Donaldson, Prof. Neurology, University of Chicago.

Dr. W. T. Eckley, Prof. Anatomy, College Physicians and Surgeons, Chicago, and Dr. Corinne B. Eckley, Demonstrator of Anatomy, same college.

Albert C. Eycleshymer, Instructor in Anat., University of Chicago.

Irving Hardesty, Ph.D., Instructor in Anat., University of California.

J. Ralph Harris, M.D., Asst. in Anat., Cornell University.

Basil C. Harvey, Asst. in Anat., University of Chicago.

Dr. Arthur E. Hertzler, Halstead, Kansas.

Dr. C. M. Jackson, Prof. Anat., University of Missouri.

Dean D. Lewis, Asst. in Anat., Univ. Chicago.

Dr. Warren H. Lewis, Instructor in Anat., Johns Hopkins.

Andrew H. Montgomery, A.B., M.B., Associate in Anat., Cornell.

Charles Aubery Parker, Instructor in Anat., Rush Med. College.

Daniel G. Revell, Associate in Anat., University of Chicago.

Dr. Fredrick C. Waite, Prof. Histology, Western Reserve University.

Dr. J. Clarence Webster, Prof. Obstetrics, Rush Med. College.

Dr. F. A. Woods, Harvard University.

The following were reelected:

Dr. T. S. Lee, University of Minnesota.

Dr. S. W. Williston, Prof. Vertebrate Anatomy and Paleontology, Kansas University, Lawrence, Kansas.

The total new members was 22, making a total membership of 153, of whom 9 are honorary.

The following recommendations of the executive committee were adopted by the Association:

1. That Section V. of the constitution be amended to read that the management of the affairs of the Association shall be delegated to an executive committee consisting of seven members, including the president and secretary, *ex officio*.

2. That three new members of the executive committee be elected at this meeting, one for three years, one for four years, and one for five years.

3. That the Association accept the offer of the editorial committee of the *American Journal of Anatomy* to furnish each member of the Association with the *Journal* at $4.50 per year; the *Journal* to publish the proceedings of the meetings of the Association, including an abstract of the papers read.

4. That the committee on circular on anatomical peculiarities of the negro be discharged.

5. That after this meeting the maximum limit of time of reading a paper shall be twenty minutes, and two papers shall not be read consecutively by the same writer.

The following officers were elected: President, Dr. Huntington, New York; First Vice-President, Dr. Lamb, Washington; Second Vice-President, Dr. Piersol, Philadelphia; Secretary and Treasurer, Dr. Huber, Ann Arbor; Executive Committee, Dr. Hamann (three years), Cleveland, Ohio; Dr. Barker (four years), Chicago; Dr. Gerrish (five years), Portland, Me.

The following was adopted, on motion of Dr. Gerrish: "The thanks of the Association are hereby given to the retiring secretary and treasurer, Dr. Lamb (who has positively declined a reelection), for his long, faithful and eminently satisfactory service." Dr. Lamb has been secretary-treasurer since 1890.

The following papers were read:

1. 'Models illustrating the Development of the Arm in Man': DR. W. H. LEWIS, Baltimore. Discussed by Drs. McMurrich, Huntington, Terry, Chas. Hill and Harrison.

2. 'A One Year Anatomical Course; its Arrangement, Merits and Disadvantages': DR. TERRY, St. Louis. Discussed by Drs. Barker and Huntington.

3. 'Factors and Stages in the Evolution of the Stomach': DR. BENSLEY, Chicago. Discussed by Dr. Huntington.

4. 'Sections of the Decalcified Body,' illustrated by specimens: DR. TERRY. Discussed by Drs. Jackson, Huber and Huntington.

5. 'A Case of Breech Presentation in a Monkey,' with specimen: DR. TERRY.

6. 'Note on the Structure of the Motor Endings in Striated Muscles': DR. HUBER, Univ. Mich. Discussed by Drs. Huntington and Bensley.

7. 'Neuro-muscular Spindles in the Intercostal Muscles': DR. HUBER. Discussed by Drs. Ingbert and Terry.

8. 'A Note on the Supracondylar Process,' illustrated by specimens: DR. TERRY. Discussed by Drs. Bensley and Huntington.

9. 'The Development of the Pulmonary Artery': DR. J. L. BREMER, Boston. Discussed by Drs. Huber and Huntington.

10. 'Skeleton with Rudimentary Clavicles, Divided Parietal Bones and other Anomalous Conditions': DR. TERRY. Discussed by Drs. Huntington, W. H. Lewis and Barker.

11. 'Skull Showing Many Wormian Bones': DR. PARKER, Chicago. Discussed by Drs. Huntington and Terry.

12. 'The Neuroglia of the Optic Nerve and Retina of Certain Vertebrates': DR. HUBER. Discussed by Drs. Minot and Barker.

13. 'Present Problems of Myological Research and the Significance and Classification of Muscular Variations': DR. HUNTINGTON, New York City. Discussed by Drs. McMurrich and Huber.

14. 'The Phylogeny of the Long Flexor Muscles': DR. MCMURRICH, Ann Arbor. Discussed by Dr. Huntington.

15 'Note on the Occurrence and Significance of the Musculus Tibio-astragalus': DR. MCMURRICH. Discussed by Dr. Huntington.

16. 'Nuclear Changes in the Muscle Cell': DR. EYCLESHYMER, Chicago. Discussed by Dr. Barker.

17. 'The Plesiosaurian Skull': DR. WILLISTON, Lawrence, Kansas. Discussed by Dr. Huntington.

18. 'The Shape of the Pyloric Glands of the Cat': DR. DEWITT. Presented by Dr. Huber, Ann Arbor.

19. 'An Illustration of the Value of the Functional System of Neurones as a Morphological Unit in the Nervous System': DR. HERRICK, Denison University, Ohio.

20. Dr. Terry showed his specimen of *Situs inversus*.

21. 'The Sphincter superior': DR. R. C. BOURLAND, University of Michigan. Read by Dr. McMurrich. Discussed by Dr. Huntington.

22. 'Development and Variation in Distribution of the Thoracico-abdominal Nerves': DR BARDEEN, Baltimore. Discussed by Dr. Huntington.

23. 'The Ducts of the Pancreas': DR. D. G. REVELL, Chicago. Discussed by Dr. Huntington.

24. 'Variations in the Distribution of the Bile Ducts of the Liver of the Cat': DR. HORACE JOHNSON, Madison, Wis. Discussed by Dr. Huntington.

25. 'Contribution to the Morphology of the Cerebellum': DR. STROUD, Cornell University. Read by the Secretary.

26. 'Histogenesis of the Sensory Nerves of Amphibia': DR. HARRISON, Baltimore. Discussed by Drs. Huber and Herrick.

27. 'The Growth of the Mammalian Spinal Ganglion': DR. DONALDSON, Chicago. Discussed by Drs. Huber and Huntington.

28. 'The Frontal Fissures in the Brains of Two Natives of British New Guinea': DR. HUNTINGTON.

The following papers were read by title:

1. 'On the Development of Connective Tissue Fibrils': DR. MALL, Baltimore.

2. 'Unusual Forms of Placentation': DR. WEBSTER.

3. 'Contribution to the Anatomy of the Scapula': DR. HRDLICKA, New York City.

4. 'Certain Racial Characteristics of the Base of the Skull': DR. HRDLICKA.

5. 'On Certain Anomalies of Bones': DR. DORSEY, Chicago.

6. 'Some Anomalies of Blood-vessels': DR. BLAIR, St. Louis.

7. 'Two Specimens of Anomalous Viscera with Left-sided Appendix': DR. HOLMES, Philadelphia.

8. 'Models of Human Pharynx of First Six Weeks' Development': DR. SUDLER, Baltimore.

9. 'The Ducts of the Submaxillary Glands': DR. FLINT, San Francisco.

10. 'Contribution to the Encephalic Anatomy of the Races': E. A. SPITZKA, New York City.

11. 'Description of the Brain of a Regenticide': MR. SPITZKA.

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*A PLEA FOR GREATER SIMPLICITY IN THE LANGUAGE OF SCIENCE.**

SCIENTIFIC ideas are with difficulty soluble in human speech. Man, in his contemplation of the flux of phenomena at work all about him, is embarrassed by the want of a vehicle of thought adequate for expression, as a child whose stammering accents do not permit him to tell his mother the new ideas which suddenly crowd upon him when he meets with something alien to his experience.

Our knowledge of the mechanism of nature has been undergoing a process of growth, much of which has been sudden. It is not surprising, therefore, that the incompletely formed ideas of science should become translated into clumsy language and that inexact thinking should be evidenced by vagueness of expression. This inexactness is often veiled by the liberal use of sonorous Greek-Latin words.

The growth of knowledge has required an increase in the medium of intellectual exchange. New conceptions have called for new terms. Sir Courtenay Boyle has pointed out that the purity of a nation's coinage is properly safeguarded, while the verbal coinage of its national language is subject to no control. Specially qualified persons prepare the standards of gold and silver. This insures the absolute purity of the measures of commercial exchange and gives the English sovereign and the American gold piece, for example, an assured circulation along all the ave-

*A paper read before Section E of the American Association for the Advancement of Science, August 28, 1901.

nues of commerce. It is not so with the standards of speech. The nation debases its language with slang, with hybrid and foreign words, the impure alloys and the cheap imports of its verbal coinage, mere tokens which should not be legal tender on the intellectual exchanges. France has an academy which in these matters has much of the authority given to the Mint, whose assayers test our metal coins; but in our country the mintage of words is wholly unrestricted, and, as a consequence, the English language, circulating as it does to all the four corners of the globe, has received an admixture of fragments of speech taken from various languages, just as the currency with which one is paid at the frontier, where empires meet, includes the coinage of several governments, each of which passes with an equally liberal carelessness.

Science ignores geographical lines and bemoans the babel of tongues which hinders the free interchange of ideas between all the peoples of the earth. Nevertheless, the international character of technical literature is suggested by the fact that three languages, French, German and English, are practically recognized as the standard mediums of intellectual exchange. One of these affords the most lucid solvent of thought, another is the speech of the most philosophical of European people and the third goes with world-wide dominion, so that each has a claim to become the recognized language of science. The brotherhood of thinking men will have been fully recognized when all agree to employ the same tongue in their intercourse, but such a 'far-off divine event' is not within the probabilities of the present, consequently there remains only for us to make the best of our own particular language and to safeguard its purity, so that when it goes abroad the people of other countries may at least be assured that they are not dealing with the debased currency of speech.

Barrie has remarked that in this age the man of science appears to be the only one who has anything to say—and the only one who does not know how to say it. It is far otherwise in politics, an occupation which numbers among its followers a great many persons who have the ability for speaking far beyond anything worth the saying that they have to say. Nor is it so in the arts, the high priests of which, according to Huxley, have 'the power of expression so cultivated that their sensual caterwauling may be almost mistaken for the music of the spheres.' In science there is a language as of coded telegrams, by the use of which a limited amount of information is conveyed through the medium of six-syllabled words. Even when not thus overburdened with technical terms it is too often the case that scientific conceptions are conveyed in a raw and unpalatable form, mere indigestible chunks of knowledge, as it were, which are apt to provoke mental dyspepsia. Why, I ask, should the standard English prose of the day be a chastened art and the writing of science, in a great scientific era, merely an unkempt dressing of splendid ideas? The luminous expositions of Huxley, the occasional irradiating imagery of Tyndall, the manly speech of Le Conte, and of a very few others, all serve simply to emphasize the fact that the literature of scientific research as a whole is characterized by a flat and ungainly style, which renders it distasteful to all but those who have a great hunger for learning.

To criticism of this sort the professional scientist can reply that he addresses himself not to the public at large, but to those who are themselves engaged in similar research, and he may be prompted to add to this the further statement that he cannot pitch the tone of his teaching so as to reach the unsensitive intelligence of persons who lack a technical education. Furthermore, he will claim that he cannot do without the use of the terms to which objection is made. However, in condemning the needless employment of bombastic words of classical origin, in place of plain English, I do not wish to be understood as attacking all technical terms. They are a necessary evil. Some of them are instruments of precision invented to cover particular scientific ideas. Old words have associations which sometimes unfit them to express new conceptions and therefore fresh words are coined. The complaint lodged against the pompous, ungainly wordiness of a large part of the scientific writing of the day is that it is an obstacle to the spread of knowledge.

Let us consider the subject as it is thus presented. In the first place, does the excessive use of technical terms impede the advancement of science? I think it does. It kills the grace and purity of the literature by means of which the discoveries of science are made known. Ruskin, himself a most accurate observer of nature, and also a geologist, said that he was stopped from pursuing his studies 'by the quite frightful inaccuracy of the scientific people's terms, which is the consequence of their always trying to write mixed Latin and English, so losing the grace of the one and the sense of the other.' But grace of diction is not needed, it may well be said; that is true, and it is also true that a clear, forceful, unadorned mode of expression is more difficult of attainment and more desirable in the teaching of science than either grace or fluency of diction. One must not, as Huxley himself remarks, 'varnish the fair face of Truth with that pestilent cosmetic, rhetoric,' and Huxley most assuredly solved the problem of how to avoid rhetorical cosmetics and yet convey deep reasoning on the most complex of subjects in addresses which are not only as clear as a trout stream, but are also brightened by warm touches of humanity, keen wit and the glow of his own courageous manhood. Nevertheless, though clearness of expression be the first desired, yet grace is not to be scorned. When you have a teaching to convey, it is well to employ all the aids which will enable you to get a sympathetic hearing. Man lives not by bread alone, much less by stones. He likes his mental food garnished with a sauce. Let the cooking be good, of course, but a *chef* knows the value of a well-seasoned adjunct to the best dish.

Our language is capable of a grace and a finish greater than we give it credit. That it is possible to write on geology, for instance, in the most exquisite simple English has been proved by Ruskin, whose 'Deucalion' and 'Modern Painters' contain many pages describing accurately the details of the structure of rocks and mountains, and dealing with their geological features in language which is marked by the most sparing use of words which have not an Anglo-Saxon origin.

The next aspect of the enquiry is whether the language of science, apart from the view of mere grace of style in literature, is not likely, in its present everyday form, to delay the advance of knowledge by its very obscurity. Leaving the reader's feelings out of the argument, for the present, it seems obvious that the whole purpose of science, namely, the search after truth, which is best advanced by accuracy of observation and exactness of statement, is hindered by a phraseology which sometimes means very much but oftener means very little, and, on the whole, is most serviceable when required as a cloak for ignorance. To distinguish between what we know and what we think we know, to comprehend accurately the little that we do know, surely these are the foundations of scientific progress. If a man knows what a thing really is, he can say so, describing it, for example, as being black or white; if he does not know, he masks his ignorance by stating in a few Greek or Latin terms that it partakes of the general quality of grayness. Writers get into the habit of using words that they do not clearly understand themselves and which, as a consequence, must fail in conveying an exact meaning to their readers. Many persons who possess only the smattering of a subject are apt to splash all over it with words of learned sound which are more quickly acquired, of course, than the reality of knowledge. Huxley said that if a man does really know his subject "he will be able to speak of it in an easy language and with the completeness of conviction, with which he talks of an ordinary everyday matter. If he does not, he will be afraid to wander beyond the limits of the technical phraseology which he has got up." If any scientific writer should complain that simplicity of speech is impracticable in dealing with essentially technical subjects, I refer him to the course of lectures delivered by Huxley to workingmen, lectures which conveyed original investigations of the greatest importance in language which was as easily understood by his audience as it was accurate when regarded from a purely professional standpoint.

Science has been well defined as 'organized common sense'; let us then express its findings in something better than a mere jargon of speech and avoid that stupidity which Samuel Johnson, himself an archsinner in this respect, has fitly described as 'the immense pomposity of sesquipedalian verbiage.' George Meredith, a great mint-master of words, has recorded his objection to 'conversing in tokens not standard coin.' Indeed the clumsy latinity of much of our scientific talk is an inheritance from the schoolmen of the past; it is the degraded currency of a period when the vagaries of astrology and alchemy found favor among intelligent men.

Vagueness of language produces looseness of knowledge in the teacher as well as the pupil. Huxley, in referring to the use of such comprehensive terms as 'development' and 'evolution,' remarked that words like these were mere 'noise and smoke,' the important thing being to have a clear conception of the idea signified by the name. Examples of this form of error are easy to find. The word 'dynamic' has a distinct meaning in physics, but it is ordinarily employed in the loosest possible manner in geological literature. Thus, the origin of a perplexing ore deposit was recently imputed to the effects produced by the 'dynamic power' which had shattered a certain mountain. 'Dynamic' is of Greek derivation and means powerful, therefore a 'powerful power' had done this thing; but in physics the word is used in the sense of active, as opposed to 'static' or stationary, and it implies motion resulting from the application of force. In the case quoted, and in many similar instances, the word 'agency' or 'activity' would serve to interpret the hazy idea of the writer, and there is every reason to infer, from the context, that he substituted the term 'dynamic power' merely as a frippery of speech. It is much easier to talk grandiloquently about a 'dynamic power' which perpetrates unutterable things and reconstructs creation in the twinkling of an eye than it is to make a careful study of a region, trace its structural lines and decipher the relations of a complicated series of faults. When this has been done and a writer uses comprehensive words to summarize activities which he has expressly defined and described, then indeed he has given a meaning to such words which warrants him in the use of them.

In this connection it is amusing to remember how Ruskin attacked Tyndall for a similar indiscretion. The latter had referred to a certain theory which was in debate, and had said that it, and the like of it, was 'a dynamic power which operates against intellectual stagnation.' Ruskin commented thus: "How a dynamic power differs from an undynamic one, and, presumably, also, a potestatic dynamis from an unpotestatic one—and how much more scientific it is to say, instead of—that our spoon stirs our porridge—that it 'operates against the stagnation of our porridge,' Professor Tyndall trusts the reader to recognize with admiration."

Among geological names there is that comfortable word 'metasomatosis' and its offspring of 'metasomatic interchange' 'metasomatic action,' 'metasomatic origin,' etc., etc. To a few who employ the term to express a particular manner in which rocks undergo change, it is a convenient word for a definite idea, but for the greater number of writers on geological subjects it is a wordy cloud, a nebular phrase, which politely covers the haziness of their knowledge concerning a certain phenomenon. When you don't know what a thing is, call it a 'phenomenon'! Instances of mere vulgarity of scientific language are too numerous to mention. 'Auriferous' and 'argentiferous' are ugly words. They are unnecessary ones also. The other day a metallurgical specialist spoke of 'auriferous amalgamation' as though any process in which mercury is used could be gold-bearing unless it was part of the program that somebody should add particles of gold to the ore under treatment. A mining engineer, of the kind known to the press as an expert, described a famous lode as traversing 'on the one hand a feldspathic tufaceous rock' and 'on the other hand a metamorphic matrix of a somewhat argillo-arenaceous composition.' This is scientific nonsense, the mere travesty of speech. To those who care to dissect the terms used it is easily seen that the writer of them could make nothing out of the rocks he had examined, save the fact that they were decomposed and that the rock which he described last might have been almost anything, for all he said of it; for his description, when translated, means literally a changed matter of a somewhat clayey-sandy composition, which, in Anglo-Saxon, is m-u-d! The 'somewhat' is the one useful word in the sentence. Such language may be described in the terms of mineralogy as metamorphosed English pseudomorphic after blatherskite. Some years ago, when I was at a small mine near Georgetown, in Colorado, a professor visited the underground workings and was taken through them. He immediately began to make a display of verbal fireworks which bewildered the foreman and the other miners whom he met in the mine, all save one, a little Cornishman, who, bringing him a bit of the clay which accompanied one of the walls of the lode, said to him, 'What do 'ee call un, you?' The professor replied, 'It is the argillaceous remnant of an antediluvian world.' Quick as a flash came the comment, 'That's just what I told me pardner.' He was not deceived by the vapor of words.

Next consider the position of the reader. It is scarcely necessary at this date to plead for the cause of technical education and the generous bestowal of the very best that there is of scientific knowledge. The great philosophers of that New Reformation which marked the era of the publication of 'The Origin of Species' have given most freely to all men of their wealth of learning and research. When these have given so much we might well be less niggardly with our small change and cease the practice of distributing, not good wholesome intellectual bread, but the mere stones of knowledge, the hard fossils of what were once stimulating thoughts. In the ancient world the Eleusinian mysteries were withheld from the crowd and knowledge was the possession of a few. Do the latter day priests of science desire to imitate the attendants of the old Greek temples and confine their secrets to a few of the elect by the use of a formalism which is the mere abracadabra of speech? Among certain scientific men there is a feeling that scientists should address themselves only to fellow scientists, and that to become an expositor to the unlearned is to lose caste among the learned. It is the survival of the narrow spirit of the dark ages, before modern science was born. There are not many, however, who dare confess to such a creed, although their actions may occasionally endorse it. On the whole, modern science is nothing if not catholic in its generosity. 'To promote the increase of natural knowledge and to forward the application of scientific methods of investigation to all the problems of life' was the avowed purpose of the greatest of the philosophers of the Victorian era.

There are those who are full of a similar good will, but they fail in giving effect to it because they are unable to use language which can be widely understood. In its very infancy geology was nearly choked with big words, for Lyell, the father of modern geology, said, seventy years ago, that the study of it was 'very easy, when put into plainer language than scientific writers choose often unnecessarily to employ.' At this day even the publications of the Geological Surveys of the United States and the Australian colonies, for example, are occasionally restricted in usefulness by erring in this respect, and as I yield to none in my appreciation of the splendid service done to geology and to mining by these surveys, I trust my criticism will be accepted in the thoroughly friendly spirit with which it is offered. It seems to me that one might almost say that certain of these extremely valuable publications are 'badly' prepared because they seem to overlook the fact that they are, of course, intended to aid the mining community in the first place and the public, whether lay or scientific, only secondarily. From a wide experience among those engaged in mining I can testify that a large part of the literature thus prepared is useless to them and that no one regrets it more deeply than they, because there is a marked tendency among this class of workers to appreciate the assistance which science can give. Take, for example, a sentence like the following, extracted from one of the recent reports of the U. S. Geological Survey. "The ore forms a series of imbricating lenses, or a stringer lead, in the slates, the quartz conforming as a rule to the carunculated schistose structures, though occasionally breaking across laminæ, and sometimes the slate is so broken as to form a reticulated deposit." This was written by one of our foremost geologists and, when translated, the sentence is found to convey a useful fact, but is it likely to be clear to anyone but a traveling dictionary? A thoroughly literary man might know the exact meaning of the two or three very unusual words which are employed in this statement, but the question is, will it be of any use whatever even to a fairly educated miner, or be understood by those who pay for the preparation of such literature, namely, the taxpayers? An example of another kind is afforded by a Tasmanian geologist who recently described certain ores as due to 'the effects of a reduction in temperature of the hitherto liquefied hydroplutonic solutions, and their consequent regular precipitation.' These solutions, it is further stated, presumably for the guidance of those who wield the pick, 'ascended in the form of metallic superheated vapors which combined eventually with ebullient steam to form other aqueous solutions, causing geyser-like discharges at the surface, aided by subterranean and irrepressible pressure.' At the same time certain 'dynamical forces' were very busy indeed and 'eventuated in the opening of fissures'—of which one can only regret that they did not swallow up the author as Nathan and Abiram were once engulfed in the sight of all Israel.

It will be well to contrast these two examples of exuberant verbosity because the first befogs the statement of a scientific observation of value, made by an able man, while the second cloaks the ignorance of a charlatan, who masquerades his nonsense in the trappings of wisdom. Here you have an illustration of the harmfulness of this kind of language, which obscures truth and falseness alike, to the degradation of science and the total confusion of those of the unlearned who are searching after information.

Let the writer on scientific matters learn the derivation of the words he uses and then translate them literally into English before he uses them, and thereby avoid the unconscious talking of nonsense. If he knows not the exact meaning of the terms which offer themselves to his pen, let him avoid them and trust to the honest aid of his own language. 'Great part of the supposed scientific knowledge of the day is simply bad English, and vanishes the moment you translate it,' says Ruskin. The examples already given illustrate this. 'Every Englishman has, in his native tongue, an almost perfect instrument of literary expression,' so says Huxley, and he illustrated his own saying. Huxley and Ruskin were wide apart in many things and yet they agreed in this. Ruskin proved abundantly that the language of Shakespeare and the Bible can be used as a weapon of expression keen as a Damascus saber when it is freed from the rust of classic importations, which make it clumsy as a crowbar.

There is yet another reason against the excessive use of Greek-English words, in particular. Greece is not a remnant of extinct geography, but an existing land with a very active people and a living language. The terms which paleontology has borrowed from the Greek may be returned by the Greeks to us. And, as Ruskin points out, "What you, in compliment to Greece call a 'Dinotherium,' Greece, in compliment to you, must call a 'Nasty-beastium,' and you know the interchange of compliments can't last long."

In all seriousness, however, is it too much to ask that such technical terms as are considered essential shall not be used carelessly, and that in publications intended for an untechnical public, as are most government reports, an effort be made to avoid them and, where unavoidable, those which are least likely to be understood shall be translated in footnotes. Even as regards the transactions of scientific societies, I believe that those of us who are active members have little to lose and much to gain by confining the use of our clumsy terminology to cover ideas which we cannot otherwise express. By doing so we shall contribute, I earnestly believe, to that advancement of science which we all have at heart.

The words which, at first, are the exclusive privilege of the specialist, gradually extend into wider use, following in the wake of that diffusion of scientific knowledge which is one of the objects of this Association. We believe that to get alongside facts, to apply the best knowledge available, to seek truth for its own sake, is as essential to the well-being of the individual life as it is to the success of a machine shop, and as beneficial to the community as it is to a smelting works.

In furtherance of this principle we must remember that language in relation to ideas is a solvent, the purity and clearness of which affect that which it bears in solution. Whewell, in 'The Philosophy of the Inductive Sciences,' has expressed this view of the matter with noble eloquence. 'Language,' he said, 'is often called an instrument of thought, but it is also the nutriment of thought; or rather, it is the atmosphere in which thought lives; a medium essential to the activity of our speculative powers, although invisible and imperceptible in its operation, and an element modifying, by its qualities and changes, the growth and complexion of the faculties which it feeds.'

In considering the subject from this standpoint, there is borne in upon the mind a suggestion which carries our thought far beyond the confines of the matter under discussion. Such power of speech as man possesses is a faculty which appears to divide him from all other living things, while at the same time the imperfection of it weighs him down continually with the sense of an essential frailty. To be able to express oneself perfectly would be divine, to be unable to make oneself understood *is* human. In 'Man's Place in Nature,' Huxley points out that the endowment of intelligible speech separates man from the brutes which are most like him, namely, the anthropoid apes, whom he otherwise resembles closely in substance and in structure. This endowment enables him to transmit the experience which in other animals is lost with each individual life; it has enabled him to organize his knowledge and to hand it down to his descendants, first by word of mouth and then by written words. If the experience thus recorded were properly utilized, instead of being largely disregarded, then man's advancement in knowledge and conduct would enable him to emphasize, much more than it is permitted him at present, his superiority over the dumb brutes. Considered from this standpoint language is a factor in the evolution of the race and an instrument which works for ethical progress. It is a gift most truly divine which should be cherished as the ladder which has permitted of an ascent from the most humble beginnings and leads to the heights of a loftier destiny, when man, ceasing to stammer forth in accents which are but the halting expression of swift thought, shall photograph his mind in the fulness of speech, and, neither withholding what he wants to say nor saying what he wants to withhold, shall be linked to his fellow by the completeness of a perfect communion of ideas.

T. A. RICKARD.

DENVER.

SCIENTIFIC BOOKS.

Geschichte der Metalle. Vom Verein zur Beförderung des Gewerbfleisses mit dem ersten Tornow-Preise gekrönte Preisschrift. Von ADELBERT RÖSSING. Berlin, Verlag von Leonhard Simon. 1901. 8vo. Pp. vi + 274.

This 'History of Metals' forms a great contrast to the 'History of the Precious Metals' by Alex. Del Mar, reviewed in SCIENCE for December 6, 1901. The latter, as we have shown, is a philosophic study of the sources and history of the *two* metals, silver and gold, the work under review deals with the occurrence (in nature), the history of discovery the chemical, metallurgical and electrical preparation, the statistics of production and the cost price of *all* the known metals, fifty-five in number. Dr. Rössing's treatise forms, consequently, a most timely and valuable complement to that by Del Mar.

The arrangement of matter is very convenient for reference; after an introduction occupying twenty-one pages, the metals are discussed in alphabetic order, the treatment being as indicated above, but limited by circumstances in many instances. The metals that have been in use from earliest times, either in native state or in ores, naturally occupy more space than those of comparatively recent origin; especially since in the former class is included the development of metallurgical operations used at different periods to make the metals available.

The occurrence in nature of many of the metals is very fully shown by lists of localities and of ores, or minerals, the latter accompanied in many cases by formulæ giving their chemical composition. References to authorities cited occupy footnotes on nearly every page, and as an example of their thoroughness may be mentioned a note calling attention to a 'peculiarly American and wonderful' company for extracting gold from sea-water, formed in Connecticut. The history and exposure of this fraud is well known to the readers of SCIENCE.

In sketching the history of processes for extracting metals from their ores, the modern extensive application of electricity has not been neglected, especially with reference to aluminium, antimony, gold, copper, silver and zinc. In this connection German, British and American patents are occasionally cited.

Unusual forms or conditions of some metals are named, and their chemical preparation described—colloidal mercury discovered by Lottermoser, and Leo's colloidal silver, but the researches of Carey-Lea seem to be unknown to the author.

Among the most valuable features of this work should be mentioned the statistics of production and the prices; when possible the figures are given for the entire nineteenth century in five-year averages; and a study of them brings out some striking features. The contrasts in production and price of aluminium are especially notable; from 1858 (three years after the labors of St. Clair Deville had made it an article of commerce) to 1884 a kilogram of aluminium was quoted at 100 marks, during the year 1890 the price per kilo fell from 27.6 to 15.2 mks., and in the following year it fell to 5 mks.; the price in 1897 was 2.5 mks., and the output amounted to three and four tenths millions of kilos, of which nearly two millions were produced in the United States. Sodium was quoted at 32.5 mks. per kilo in 1866, and at 5 mks. in 1897. Manganese has suffered an extraordinary fall in price, showing that as soon as an article is positively demanded by commerce, means for securing it cheaply are devised; in 1886 manganese was quoted at 550 mks. per kilo, and four years later at 40 mks.; it fell in 1896 to 16 mks. per kilo.

The price of metallic sodium in 1879 was 20. mks. per kilo, and it had fallen to 5 mks. in 1897. Some metals of minor importance maintain a relatively uniform price, as antimony and palladium; while that of platinum has risen from 500 mks. per kilo in 1870 to 1297 mks. in 1895, and largely owing to the demand made for it by electrical apparatus.

In pleasing contrast to these rapid fluctuations in price is the steady behavior of the king of metals—gold; the figures (in part) are as follows:

1801–05,	2736.8	mks.	per	kilo.
1846–50,	2736.3	"	"	"
1876–80,	2730.7	"	"	"
1891,	2736.3	"	"	"
1892,	2743.2	"	"	"

The important bearing of this is obvious to students of monetary science.

The author is to be commended for the pains he has taken to prepare a valuable work of reference; the reviewer regrets that he feels obliged to point out a blemish in the manufacture of the volume, for which the publisher is primarily responsible. The running-head lines, particularly important in a dictionary or a book on the alphabetic plan, have been omitted and their place is inadequately filled by the page numbers; this makes it difficult to find a given metal readily, although in alphabetic order, except by scanning the text closely on a given page, or by examining the table of contents. This economy by publishers is to be deprecated. HENRY CARRINGTON BOLTON.

Practical Marine Engineering, for Marine Engineers and Students, and with Aids for the Applicants for Marine Engineers' Licenses. By WM. F. DURAND, Professor of Marine Engineering, Cornell University. New York, Marine Engineering Co. 8vo.

It too seldom occurs that men of high attainments and experts in their professions, possessed of both technical and scientific, practical and 'theoretical,' knowledge, are either able or willing to give time and thought to the production of works of this sort, and the task of provision of much-needed text-books and hand-books is too generally left either to the man of science without expert knowledge in the practical field or to the practitioner lacking sound and extensive scientific culture and training. This, which is a text-book for those desiring to secure practical knowledge of marine engineering with, at the same time, accurate understanding of its scientific foundations, is a model which it is to be hoped will furnish stimulus to many other able men in as many other departments. Its field is well laid out, its scheme and details well planned and handled and it is concise, simple, clear and satisfactorily full. Dr. Durand is an authority in his department, expert in its practice and familiar with its scientific basis, accustomed to combine science with practice, an experienced engineer, a trained and successful educator. The book is authoritative and cyclopedic and in it practical marine engineering is reduced to its simplest and most exact terms.

Its chapters discuss the materials of engineering, including the fuels, their methods of preparation and production, and their characteristics and qualities; boilers and their construction; marine engines, auxiliaries and accessories, their operation, management and repair. Special topics and problems illuminate and render usefully applicable the principles enunciated; and the second part of the work is devoted particularly to 'Computations for Engineers,' carefully selected and skilfully solved problems.

The introduction on board the modern steamship of refrigerating and other special machinery leads to the study, in appropriate chapters, of the apparatus of electric light and power distribution and of refrigeration, their care and management. These chapters are admirably concise and yet complete for their purpose.

The book is well made, the type excellent and the illustrations clear and freely supplied, especially as illustrating the details of construction of marine machinery. So far as can be seen at a first review of its contents, the book is thoroughly up to date and very accurate, a credit alike to author, publisher and printer. It has its origin, apparently, in the public spirit and enterprise of the publishers of the technical journal, *Marine Engineering*, under whose imprint it appears.

R. H. T.

Studies in Physiological Chemistry. Edited by R. H. CHITTENDEN, Ph.D. New York, Scribner's Sons. 1901.

This volume of 424 pages, one of the Yale Bicentennial publications, contains reprints of the more important studies issued from the laboratory of physiological chemistry of Sheffield Scientific School of Yale University, during the years 1897–1900.

The twenty-six papers, representing the work of Professor Chittenden and his pupils during this time, are simply reprints from the *American Journal of Physiology*, the *Journal of Experimental Medicine* and *Zeitschr. f. physiol. Chemie*, Bd. XXIX., and form a valuable sequel to the three volumes of studies previously issued from this laboratory in 1885, 1887 and 1889. A complete bibliography of the Sheffield Laboratory of Physiological Chemistry from its commencement in 1875 until the end of the year 1900 is also given.

As these studies are more or less familiar and as they have been reviewed in the original, it is hardly necessary to enter into any detailed criticism of them. In viewing the work coming recently from this laboratory, one is struck with the radical change in direction in the line of research from the earlier investigations. It would be most interesting to have researches from the Sheffield laboratory on the products of proteolysis, in view of the recent researches of Kutscher, Siegfried, Balke, Lawrow, Pick and others. This line of work, so ably carried out by Kühne and Chittenden in 1883–4, has undergone such radical modifications in latter years that the views and investigations of one of the pioneers would be most valuable to science. Although Professor Chittenden attempts to reconcile his views in regard to antipeptone with modern investigations, in an addendum to 'a chemico-physiological study of certain derivatives of the proteids,' page 321, still we think he fails to make his point very clear.

John A. Mandel.

Primitive Man. By Doctor Moriz Hoernes. Translated into English by James H. Loewe, London, 1900. Dent and Co. Pp. 136, Figs. 48.

This handy little 16mo volume forms the twenty-third number in the series of Temple Primers designed by the publishers to furnish, for a shilling a copy, the best and latest results of scholarship to the average reader who cannot afford the costly encyclopedias. Beginning with the subject of man's place in nature the author sums up the characteristics of culture, the earliest traces of man, the ages of stone, bronze and iron; and the primitive history of the Aryans and Semites. Small space is given to the Western Hemisphere, but that is fortunate in two ways, for some wild guessing has been done on that topic, and, secondly, American readers will be glad to have a handy little guide book to European archeology. Not one American authority is mentioned in the bibliography and no European work later than 1894.

O. T. Mason.

Anleitung zur mikroskopischen Untersuchung der vegetabilischen Nahrungs- und Genussmittel. By Dr. A. F. W. Schimper, ö. Professor der Botanik an der Universität Basel. Second revised edition. Jena, Verlag von Gustav Fisher. 1900.

A melancholy interest attaches to the consideration of this book owing to the recent death of Dr. Schimper in the prime of life. Here in a space of 150 pages we have a very attractive and useful introduction to the microscopic appearance of flours, starches and their adulterants; of coffee and its adulterants; cocoa, chocolate, tea, tobacco, pepper, cloves, allspice, red pepper, mustard, saffron, cinnamon, vanilla, cardamon, nutmeg, mace, ginger and turmeric. There is also a chapter on the adulterants of fruit jellies, and one on honey. The book contains a good index and 134 figures, which are well drawn and very attractive. Among the substances used for adulterating coffee Schimper mentions the following: Chickory, beets, carrots, figs, various cereals, lupin seeds, acorns, carobs, dates, vegetable ivory, potatoes. These are described in a space of twenty pages with seventeen illustrations. Under fruit jellies, we learn that agar-agar is frequently employed for their adulteration and that this substance may be detected readily by means of the microscope, owing to the fact that these seaweeds always have numerous diatoms clinging to their surface, as any one may determine readily by burning a small quantity of agar-agar in a platinum dish, adding to the ashes a few drops of water rendered acid by HCl and then examining under high powers of the microscope. When jellies are suspected of adulteration with agar-agar, the author recommends that the mass of jelly be boiled with about five per cent. dilute sulphuric acid, and then that a few crystals of permanganate of potash be carefully added. The previously suspended diatom shells now fall to the bottom and form a more or less rich sediment, which may be examined without any further preparation.

In this age of haste to be rich at any cost, the extension of the adulteration of food products has become very great, and the knowledge contained in books of this kind increases yearly in importance, not only to the special worker, but to the general public. The moderate price of four Marks in paper covers, or five Marks, bound, puts the book within the reach of every one.

Erwin F. Smith.

Use-Inheritance illustrated by the Direction of Hair on the Bodies of Animals. By Walter Kidd, M.D., F.Z.S. London, Adam and Charles Black. 1901.

This is an interesting contribution to the dynamic or Lamarckian principles of evolution. Dr. Kidd has first treated of the formation of whorls in the hairy coats of mammals; and second, the slope of hair in certain selected regions of the bodies of animals and man. In the domestic horse there are five regions where whorls occur—*i. e.*, the frontal, inguinal, pectoral, post-humeral or axillary, and cervical. These are due, the author shows, to the traction of the underlying muscles. It is interesting to observe that they are absent in the zebra, and are apparently the result of the movements and work done by the horse in a state of domestication. 'It is difficult,' the author concludes, 'to see any explanation of the formation of whorls, featherings and crests in the hairy coats of mammals other than a dynamical one.' His reasons for the dynamical view are as follows:

1. They all occur, except that on the vertex, in regions where opposing traction of underlying muscles is found.

2. They never occur over the middle of a large muscle, and seldom in any place where there is not a hollow or groove in the superficial anatomy.

3. They are most uniform and most marked in animals with very strong muscles, and those that are actively locomotive.

4. Their constancy appears to depend upon range of action and activity of function of the muscles in the part and individual animal affected. This is especially shown in the three regions of the domestic horse—pectoral, post-humeral and inguinal.

As regards the hair slope, the author arrives at the following conclusions:

1. To understand the disposition of hair on living animals, it is necessary to look upon it as a stream, and this is very plastic.

2. In man, and various groups of animals, the great majority of the peculiarities here noted are congenital.

3. Certain peculiarities of hair-slope are at present in process of development.

4. The hair streams are disposed in the lines of least resistance.

5. The mechanical conditions required for the production of both the general and the special hair-slopes are in present operation.

6. The hair-slope can be modified during the life of an individual.

7. Selection (whether natural, sexual or germinal) is incompetent to produce these peculiarities of hair-slope.

8. If these are not originally created with the forms of life which present them, they must have been produced in ancestors by use or habit.

The author seems to have made out a good case and to have been led by the legitimate use of the inductive method to what seem to be valid and natural conclusions.

A. S. P.

Some Fossil Corals from the Elevated Reefs of Curaçao, Arube and Bonaire. By T. WAYLAND VAUGHAN. Sammlungen des Geologischen Reichs-Museums in Leyden, Ser. 11, Bd. 11, Heft. 1901.

Mr. Vaughan makes his report upon the fossil corals from the Dutch West Indies, collected by Professor K. Martin, director of the Leyden Geological Museum, part of an elaborate study of the history and synonymy of the West Indian corals. The paper is companion to another by the same writer, shortly to appear, upon the stony corals of Porto Rico collected by the recent survey of the U. S. Fish Commission. The latter will contain photographic reproductions of most of the living species of West Indian corals. Both papers are subsidiary to a larger work upon the post-Eocene Corals of the United States, now in the course of preparation.

The author is preeminently qualified for the task he has undertaken. In addition to having access to the large accumulations of corals at the U. S. National Museum and Geological Survey, including the type specimens of Dana, he has visited the collections in London, Paris, Berlin, Turin and other centers, where are contained the types of Milne-Edwards and Haime, Ehrenberg, Klunzinger, Duncan, Duchassaing and Michelotti, and other workers on the corals. In some way the present revision is a continuation of the work of Professor J. W. Gregory on the fossil corals of Barbados.

The result is what might have been expected. With the further accumulation of material for study, enabling the possible variations within the limits of a species to be estimated, and the comparison of the type specimens of different investigators, either side by side, or by the aid of photographs, it has been possible to bridge over a large number of the gaps which separate certain so-called species, and to demonstrate that many of the latter are but varieties of growth in a somewhat protean group. Thus, to take a couple of instances: *Orbicella acropora* (Linnæus) now embraces ten species, and has been known under the same number of genera; *Meandrina meandrites* (Linnæus) has a synonymy in which are represented seven genera and thirteen species.

Unfortunately the revision of the synonymy reveals the necessity for several important changes in long-established names if the rules of nomenclature are to be strictly followed. Vaughan now shows that the true *Meandrina* is not the brain coral which students, from the time of Milne-Edwards, have been accustomed to associate with the name, but is the *Pectinia* of Milne-Edwards, while the *Meandrina* of the 'Coralliaires' has for the future to be known as *Platygyra*. It is with a sigh that one relinquishes *Madrepora* for the corals so long associated with this name. As was first pointed out by Geo. Brook, in the British Museum Catalogue of the Madreporaria, none of the species at present included under *Madrepora* were embraced by Linnæus when he instituted the term in 1758. Vaughan now suggests its replacement by *Isopora*, a name first used in the subgeneric sense by Studer in 1870.

The writer follows Brook in regarding all the forms of the West Indian *Madrepora* as but one species, the three Lamarckian species —*palmata, cervicornis* and *prolifera*—being reduced to formæ or varieties. Gregory in 1895 had come to the same conclusion as Brook, but in 1900, following upon a visit to the West Indies, and the opportunity of seeing the different representatives in situ, he reverts to the Lamarckian arrangement, and endeavors to dispose of the specimens which Brook regarded as intermediate in form.

In the immense coral flats around the various Antillean islands the three types of *Madrepora* growth usually retain a remarkable distinctness of form, though often growing side by side; and from a study of these alone one would be far from induced to admit their specific unity. The polyps, however, are practically alike in form and color, and anatomically and histologically they reveal no important differences. Vaughan also believes that he possesses colonies which should be regarded as intermediate in habit between the three recognized types. In his forthcoming Porto Rican paper the author proposes in like manner to unite under two groups the many and varied West Indian representatives of the allied genus *Porites*.

It might have been supposed that the study of the polyps themselves, both in their living condition and anatomically and histologically, would have revealed distinctions tending to strengthen the specific separations founded upon the skeletal form. But such is not the case. A comparative study of the polyps of many so-called species of *Madrepora, Porites, Orbicella,* etc., now in progress reveals very few differences within each genus. Compared with those of *Madrepora* the polyps of *Porites* vary greatly in color, often on the same colony, but except for slight variations in size no other differentiations of importance can be established in any part of their structure.

Extensive studies like those now being undertaken by Vaughan indicate that the greater the number of specimens of Madreporarian corals which are studied, with regard both to the skeleton and soft parts, the greater will be the tendency to lessen the number of species. As it has been expressed by the author: "The number of species is very often a function of the amount of the material studied." The same tendency has already reached its climax in the case of the Hydrozoan coral, *Millepora*. In the course of a study of both polyps and skeleton of this genus, extending over many years, and embracing specimens from all parts of the world, Professor Sidney Hickson has recently come to the conclusion that it is impossible to maintain any specific distinction. All the numerous skeletal forms, hitherto included under about thirty-nine names, are, from Hickson's researches, to be regarded as but so many varieties of growth, which presumably may be assumed by any one individual under like conditions.

Zoologically the tendency is healthy. For the student's time will be set free to investigate collections of specimens from other standpoints than that of assigning each its name, animated by the desire to produce the longest possible list. Variations in a form will be studied as modifications adapted to particular environments. In museums the specimens can then be arranged, not as objects with so many long names as appendages, but as illustrating vital principles of natural history.

J. E. DUERDEN.

JOHNS HOPKINS UNIVERSITY,
BALTIMORE, MD.

GENERAL.

A NEW edition of Stieler's Handatlas to contain 100 copper-plate maps is now in course of publication by Perthes of Gotha, in fifty parts; the price of the complete work being 30 Marks. Half the maps are newly projected and engraved. All of them have relief in brown, in order to make the names in black more legible. In preparation for binding, each sheet has its title printed on the right corner of the back, with on outline map that indicates the location of the sheet and of the neighboring sheets with their numbers. The present edition is the ninth of this valuable work; the first having been completed by Stieler in 1831. Later editions were by Stülpnagel. Petermann, Berghaus and Vogel.

SCIENTIFIC JOURNALS AND ARTICLES.

THE January (opening) number of Vol. III. of the *Transactions of the American Mathematical Society* contains the following papers: 'On a Class of Automorphic Functions,' by J. I. Hutchinson; 'Concerning the Existence of Surfaces Capable of Conformal Representation upon the Plane in such a Manner that Geodetic Lines are Represented by a Prescribed System of Curves,' by H. F. Stecker; 'Zur Erklärung du Bogenlänge und des Inhaltes einer krummen Fläche,' by O. Stolz; 'The Groups of Steiner in Problems of Contact,' by L. E. Dickson; 'Quaternion Space,' by A. S. Hathaway; 'Reciprocal Systems of Linear Differential Equations,' by E. J. Wilczynski; 'On the Invariants of Quadratic Differential Forms,' by C. N. Haskins; 'The Second Variation of a Definite Integral when One End-point is Variable,' by G. A. Bliss; 'On the Nature and Use of the Functions Employed in the Recognition of Quadratic Residues,' by E. McClintock; 'A Determination of the Number of Real and Imaginary Roots of the Hypergeometric Series,' by E. B. Van Vleck; 'On the Projective Axioms of Geometry,' by E. H. Moore.

THE December number (Vol. VIII., No. 3) of the *Bulletin of the American Mathematical Society* contains the following articles: 'The October Meeting of the American Mathematical Society,' by Edward Kasner; 'Modern Methods of Treating Dynamical Problems and in Particular the Problem of Three Bodies,' by E. W. Brown; 'The Hamburg Meeting of the Deutsche Mathematiker-Vereinigung,' by C. M. Mason; 'Some Curious Properties of Conics Touching the Line Infinity at One of the Circular Points,' by E. V. Huntington and J. K. Whittemore; 'Picard's Traité d'Analyse,' by Professor Maxime Bôcher; 'Errata,' 'Notes' and 'New Publications.' The January number of the *Bulletin* contains: 'Note on Mr. George Peirce's Approximate Construction for π,' by Emile Lemoine; 'Concerning the Elliptic $\wp(g_2, g_3, z)$-Functions as Coordinates in a Line Complex, and Certain Related Theorems,' by H. F. Stecker; 'On the Abelian Groups, which are Conformal with Non-Abelian Groups,' by G. A. Miller; 'The Infinitesimal Generators of Certain Parameter Groups,' by S. E. Slocum; 'Shorter Notices'; 'Notes' and 'New Publications.'

SOCIETIES AND ACADEMIES.

CHEMICAL SOCIETY OF WASHINGTON.

THE 130th regular meeting was held December 12. The following program was presented:

'The Solubility of Mixtures of Sodium Chloride and Sodium Sulphate': A. SEIDELL.

The author first gave a brief summary of the status of solubility work in solutions other than very dilute ones, and described in detail the experimental difficulties which have to be met in this kind of work. He then presented a diagram illustrating the solubility curves for the system $NaCl—Na_2SO_4—H_2O$ at 10°, 21.5°, 25°, 27°, 30°, 33° and 35°. It was shown that at temperatures above 33° the curves represented equilibrium conditions between sodium chloride and anhydrous sodium sulphate, and no abnormalities presented themselves. Between 33° and 17°, however, it was found that in solutions containing but small amounts of sodium chloride and in contact with solid sodium sulphate, the equilibrium conditions were determined by the solid salt being in the form of the decahydrate, and the solubility curves for this decahydrate are very much flatter than the corresponding curves for the anhydrous salt. But as the amount of sodium chloride in the solution increased, at temperatures between 33° and 17°, there was always a sudden change in the direction of the solubility curve for sodium sulphate, which was found to be caused by the sodium sulphate present as solid phase, having gone over to the anhydrous form. In order to check this view, the experiment was made of placing large well-formed crystals of sodium sulphate decahydrate in two test-tubes, one containing a saturated solution of sodium sulphate alone, and the other a solution nearly saturated with sodium chloride, as well as sodium sulphate. Both test-tubes were fitted with cork stoppers carrying thermometers. They were then immersed in a water-bath and the temperature gradually raised. At 28° the crystals in the sodium chloride solution gradually became opalescent around the edges, then rather rapidly became entirely opaque and showed a tendency to fall apart in a loose powder. The material had undoubtedly gone over to the anhydrous salt, although the crystals which were in the tube containing only water and sodium sulphate showed no change until the temperature reached 33°. It thus appeared that the transition temperature for the change of sodium sulphate decahydrate to anhydrous salt had been displaced by the presence of sodium chloride. This was regarded as of considerable significance, and is important in connection with the suggestions on this subject in the study of the change of gypsum to calcium sulphate hemihydrate, made by Van't Hoff and Armstrong, Vater and Cameron.

The solubility curves for sodium sulphate heptahydrate in solutions of sodium chloride were shown to be very similar to those for the decahydrate. In the case of the decahydrate at lower temperatures and the heptahydrate, the curves were shown to have minimum points, the significance of which is not apparent at the present time.

'The Evolution of Metallic Retorts' (with samples): W. H. Seaman.

Before commencing the paper the speaker showed a very perfect copy, just received from England, of Boerhaave's 'New Method of Chemistry,' in two volumes, second edition, 1741. Boerhaave was born in 1668, died in 1738, was famous as a physician, botanist and chemist, and was one of the first to recognize the independence of the latter science.

The first metallic retorts were copper flasks just like the olive-oil flasks of the early chemists with a gallows screw added. In a lot of scrap of Professor Henry's apparatus about to be sold thirty years ago, the author found two wrought-iron retorts with walls a centimeter thick, and shaped just like a glass tubular retort that are types of this class.

The next retort exhibited was a pear-shaped vessel. It had a feed wheel on top, and was set in an egg stove, the bottom made red hot and $KClO_3$ fed in by the wheel. The O was taken off by the side pipe.

Next was a kettle-shaped retort patented by the author. Its peculiarity is that all parts draw together by the gallows screw, while the top is durable with ground joint, and the bottom, being thin, heats quickly and can be cheaply renewed.

Next we have the cylindrical sheet metal retort which admits of moving the bunsen burner along its length so as to decompose the charge in successive portions.

The latest development is the little frustrum of a cone, with gallows screw top and two pipes, one for delivery and one for the introduction of an inert gas or other purpose that may be desired. In this oxygen may be made, coal distilled, etc. They are sold by the Chicago Laboratory Supply Co., price one dollar, and are one of the most useful acquisitions we have lately had made to laboratory apparatus.

'Starch as an Adulterant or Drier in Butter, and a Study of Glucose in Butters': G. E. PATRICK and D. STUART.

1. The paper describes first a canned butter which was found to contain, besides about 15 per cent. of glucose, 3.15 per cent. of starch, either potato starch or a variety closely resembling it. The starch was probably added as a drier; it is said to be sometimes used for this purpose in remanufactured butter. The complete analysis of this butter was: water, 27.19; fat, 40.36; ash, 12.65 (all NaCl except .65 impurities); casein (N x 6.25), 0.86; starch, 3.15; other organic matter, 15.8. Assuming .3 per cent. of lactose, there remains 15.5 per cent. of organic matter which was set down as glucose, since no other organic substance was identified. The aqueous extracts, of 100 cc. volume, from 26.05 grams of the butter, that is, a 'normal sugar solution,' polarized 26.2 degrees on the cane sugar scale (Soleil-Ventzke).

2. With four glucosed butters studied, whole 'normal sugar solutions' polarized respectively 7.0, 11.0, 18.5 and 26.2 degrees, and whose percentages of organic matter designated glucose (as in the case above) were respectively 7.0, 7.9, 10.6 and 15.5 per cent., the rotary and copper reducing powers of the aqueous extracts being referred to these amounts of dry matter, the copper reducing power was in every case (possibly excepting one) too low to correspond to the rotary power, according to Rolfe and Defren, if the entire matter were pure glucose. Sucrose was suspected and inversion was tried by means of saccharine, following the method of Tolman. In only two of the four cases was the rotation appreciably lowered. In these two—and these two butters were canned by the same firm—there was a marked reduction of rotation, indicating (of course not proving) the presence of cane sugar to the amount of about 1.3 per cent. on the butters. The increase of copper reduction, by inversion, was not determined at the time; but several weeks later, the small residual samples having been meantime at laboratory temperature, one was tested, and the increased copper reduction after inversion was found to correspond to .83 per cent. sucrose in the butter, while the decrease of rotation by inversion at this time corresponded to only 1.0 per cent. sucrose. As glucose is added to butters in the form of a sirup, and as there are upon the market glucose sirups containing admixture of cane sugar, the presence of the latter in a glucosed butter need not be so very surprising. Aqueous extracts, 'normal sugar solutions' of 49 non-glucosed butters polarized from 0 to .5 degree, averaging .22 degree. Five ladled butters out of 15 examined polarized from 3.4 to 5.7 degrees, showing admixture of glucose. Glucose is frequently used by ladlers to improve the appearance of their product.

L. S. MUNSON,
Secretary.

ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

THE 324th meeting was held December 7. Mr. Paul Beckwith presented a type series of Philippine swords, from the National Museum, with description of their use, and stated the rank and people to which each sword belongs.

President W. H. Holmes presented some rare examples of ancient Mexican art, lately acquired by the National Museum. These consisted of pottery and stone carvings, showing exceptional artistic feeling in their treatment.

The paper of the evening was on 'Le Culte des Pierres en France,' by M. Paul Sebillot, translated and read by Mr. Jos. D. McGuire. Some months ago an arrangement was made between the Société d' Anthropologie de Paris and the Anthropological Society of Washington to exchange communications for one meeting during the winter. M. Sebillot's paper is the result of this intersociety comity. M. Sebillot has made extensive historical and observational researches on the great body of folk-lore and customs connected with the megalithic monuments of France, which really constituted a cult of stones coming down from ancient times. In general the customs are divinitory and may be grouped under the head of lithomancy, the idea being to look into the future, for instance, the maids as to marriage and the matrons as to fecundity. On the whole the Cult des Pierres seems to be feminine. The strange customs long inhibited are still secretly practiced in France and M. Sebillot has handled this delicate subject with great detail and frankness. The paper was illustrated by a large series of photographs of the megalithic monuments, lent by Dr. Thomas Wilson.

Dr. J. Walter Fewkes in discussing the paper said that he appreciated this great contribution to knowledge, and further that a number of customs among the Zuni and Moki are similar to those mentioned by M. Sebillot. Mr. W J McGee and Dr. Thomas Wilson also discussed the question of the worship of stones in America.

The Society passed a vote of thanks to M. Sebillot and requested the publication of the paper in the *Anthropologist.*

WALTER HOUGH.

DISCUSSION AND CORRESPONDENCE.

NOTES ON CUBAN FOSSIL MAMMALS.

TO THE EDITOR OF SCIENCE: The reported occurrence in Cuba of certain fossil mammals has been used by several geologists, the first of whom was Manuel Fernandez de Castro, as evidence of former land connection between Cuba and the continent of North America in Pleistocene time.

The fossil mammals reported from this island belong to the genera *Hippopotamus, Equus, Mastodon* and *Megalocnus,* a subgenus of *Megalonix.* Leidy* examined specimens sent him by Poey, and published the opinion that the remains of the horse appear not to differ from the corresponding parts of the recent animal, and it is even doubtful if they are to be considered indigenous fossils. Concerning the hippopotamus remains, which consisted of isolated canines, he says that 'they probably also belong to the recent animal.' The same opinion was expressed by Pomel.† Vertebrate paleontologists do not consider isolated horse teeth sufficient data for the determination of species. So far as I have been able to glean from the literature, the remains of the so-called fossil horses from Cuba, reputed to be of Pleistocene age, are fragmentary, and therefore cannot be considered as possessing any paleontologic value. It has been shown that the *Mastodon** remains were not indigenous to Cuba, but were contained in a box of fossils from Honduras sent by del Monte to the Royal Academy of Sciences of Havana.

* *Proc. of the Acad. of Nat. Sci. Phila.*, Vol. XX., 1868, pp. 179.

† *Comptes Rendus*, Paris, Vol. LXVII., 1868, p. 850.

These notes seem to show conclusively that the three mammals considered above were not indigenous to the island of Cuba.

The fourth genus, *Megalocnus,* remains to be considered. According to de Castro's first notice,† this specimen was collected at Ciego Montero, a place noted for warm baths, in the jurisdiction of Cienfuegos, by José Figueroa, a young student of the Royal University. This reference is given as a quotation from a note read by Poey to the Havana Academy in 1861. I have not seen this note by Poey in print. The subsequent publications until 1892 are simply quotations of the above given locality. In the *Anales de la Real Academia de la Habana,* Vol. III., page 656, April, 1871, a note is inserted by Poey asking for information concerning the locality of certain large fossils which were sent to de Castro. On page 698 of the same volume it is stated that this box of fossils was sent by Leonardo del Monte to the Havana Academy of Sciences and contained three fossils from Honduras. According to the note of Poey‡ this box contained specimens of *Mastodon humboldti,* but Poey himself does not verify the locality whence the *Megalocnus* came.

As there have been so many extraneous fossils confused in the so-called Cuban fossil mammalian fauna, it has occurred to me that

* For note by Poey regarding the original locality of the *Mastodon, M. humboldti,* see *Anal. Real. Acad. Cien. Habana,* Vol. VIII., pp. 124–126, August, 1871.

† *Anal. Real. Acad. Cien Habana,* Vol. I., p. 58, Sept., 1864.

‡ *Anal. Real. Acad. Cien. Habana,* Vol. VIII., pp. 124–126.

the specimens of *Megalocnus* might have been contained in this box of fossils from Honduras, or they may have come from some locality not in Cuba.

The only evidence which seems to contradict this expression of doubt is that given by de la Torre* in his 'Observaciones Geológicas y Paleontológicas en la región central de la Isla (Cuba).' In this article additional localities, the vicinity of Cárdenas and between Santo Domingo and Sagua, are recorded. I am not able to express an opinion as to the correctness of these localities or on Torre's ability to determine fossil vertebrates. I am inclined to doubt because there has been so much error regarding those fossils concerning which we have subsequently been able to procure definite data.

The question which I wish here to bring to the attention of vertebrate paleontologists is: Are vertebrate fossils of the genus *Megalocnus* found in Central America, especially in Honduras?

A note may be added upon the question of the priority of the name *Megalocnus* Leidy, and *Myomorphus* Pomel. The note by Leidy was published in the *Proceedings of the Academy of Natural Sciences of Philadelphia,* Volume XX., pages 179–180. The date given at the bottom of the page is June–July, 1868. The article by Pomel was published in the *Comptes Rendus de l'Academie des Sciences,* Paris, Vol. LXVII., for the second half, July to December, 1868, pp. 665–668. This is the account of the proceedings of the session of Monday, September 28, 1868. Apparently Leidy's name antedates that of Pomel by several months.

The recent mammalian fauna of Cuba consists of only two genera, a rodent, *Capromys,* which possesses species in several other West Indian Islands. It is a peculiar genus, having its nearest relatives in the Octodont rodents of South America. There are no relatives at all on the North American continent. The other genus is a peculiar large insectivore, *Solenodon.* This animal is entirely different from anything found in any other part of America.

* *Anal. Real. Acad. Habana,* Vol. XXIX., pp. 121–124, August, 1892.

It is most closely related to a genus, which is very different, found in Madagascar. If there had been any Pleistocene connection between North America and Cuba it would have inevitably caused a considerable similarity between the mammalian faunas of the two regions. However, none of the common mammalian types of the continent, such as cats, raccoons, hares, etc., are found in that island.

T. WAYLAND VAUGHAN.

SMITHSONIAN INSTITUTION,
December 18, 1901.

THE ENGLISH SPARROW IN NEW MEXICO.

FOR some time we have known of the presence of this bird at Raton and Las Vegas. I have now for the first time observed it at Albuquerque, the birds being fairly numerous in the immediate vicinity of the railway station.

T. D. A. COCKERELL.

SHORTER ARTICLES.

NEJED: AN ARABIAN METEORITE.

AMONG a considerable number of important specimens lately added to the Ward-Coonley Collection of Meteorites, now on display at the American Museum of Natural History in New York, is a mass or single bolide of iron from Western Australia called the Youndegin or Penkaring Rock Meteorite. It is one and one half feet in greatest diameter, and weighs between 300 and 400 pounds. Its companion piece, which is in the Royal Museum of Vienna, weighs 910 kilogrammes (half a ton) and is with Cranbourne, also from Australia, one of the largest two meteorites from the entire Eastern Hemisphere.

But of even more interest is the subject of the present notice: the Nejed Meteorite from Central Arabia. It is a siderite or iron meteorite, whose form is rudely triangular, flattened in its longest diameter, which is about fourteen inches, while its thickness below is eleven inches, and its breadth, or height, about nine inches. Its surface is completely and very handsomely covered with the pittings so frequent in meteorites, whether of iron or of stone. The sharpness of these depressions and the brightness of the iron—with entire absence of weathering—are noticeable features, as strongly indicating the recentness of the fall. Nejed was a meteorite which fell in two masses, one of 131 pounds, the other of 136½ pounds. The former was brought to Europe in 1885, and was sold to the British Museum, where it has since been on display. Mr. Fletcher has given (*Mineralogical Magazine*, 1887) some interesting points as to its finding. It was brought to London by a Persian agent who delivered it at the Museum, at the same time submitting a letter from his Excellency Hajee Ahmed Khanee Sarteep, Ex-Governor General of Bunder Abbas, Persian Gulf, and Grand Vizier of Muscat. The letter sent from Bunshire, and with the Persian date 14th Di Koodah, 1301, A. H., says:

"In the year 1282, after the death of Mahomed, when Maime Faisole Ben Saoode was Governor and General-Commander-in-Chief of the Pilgrims, residing in a valley called Yakki, which is situated in Nagede (Nejed) in Central Arabia, Schiek Kolaph Ben Essah, who then resided in the above-named valley, came to Bushire, Persian Gulf, and brought a large thunderbolt with him for me, and gave me the undermentioned particulars concerning it.

"'In the spring of the year 1280, in the valley called Wadee Banee Kholed in Nagede, there occurred a great storm, with thunder and lightning; and during the storm an enormous thunderbolt fell from the heavens accompanied by a dazzling light, similar to a large shooting star, and it sank deep into the earth. During its fall the noise of its descent was terrific. I, Schiek Kolaph Ben Essah, procured possession of it and brought it to you, it being the largest that ever fell in the district of Nagede. These thunderbolts, as a rule, only weigh two or three pounds, and fall from time to time during tropical storms.'

"The above concludes the narrative of Schiek Kolaph Ben Essah. The said Schiek, who brought me this thunderbolt, is still alive and under Turkish Government control at Hoodydah near Jeddah. I myself saw in Africa, four years after the above date, a similar one, weighing about 135 pounds, to that which Schiek Kolaph Ben Essah brought to me.

"The Sultan of Zanzibar, Sayde Mazede, obtained possession of it and sent it to Europe, for the purpose of having it converted into weapons, as when melted and made into weapons they were of the most superior kind and temper. For this reason I have forwarded my thunderbolt to London, considering it one of the wonders of the world, and may be a benefit to science."

(Signed)

Hajee Ahmed Khanee Sarteep,

Ex-Governor of Bunder Abbas, and Grand Vizier of Muscat.

Any reader of the above letter will be impressed with its straightforward narrative, even though the writer gives credence to the popular idea—not at all confined to Arabia—that meteorites fall during thunder storms. His remark that thunderbolts in his country usually weigh only two or three pounds is also of an ingenuous naïveté not incompatible with truthful sincerity. There is a similarity like to that of general human nature—which marks tales of meteorites in every part of the world, the phenomena accompanying their fall, which are also strikingly similar, helping toward this. In this present case the meteorite itself was forthcoming to justify the narrative, and its fellow followed closely after: the piece which the Grand Vizier mentions having seen in Zanzibar and which the Sultan of Zanzibar, at that time also Sultan of Muscat (which district borders close upon that of Nejed), sent also to Europe to have converted into weapons. It reached London, and also went to the British Museum, where, they being already provided, Director Fletcher sent them with this second piece to Mr. James R. Gregory—a celebrated collector of meteorites, who promptly added it by purchase to his collection. From the heirs of Mr. Gregory I a few months ago obtained it, and gave it a place of honor, becoming its uniqueness, in the Ward-Coonley Collection. In view of the fact that Sayde Mazede, the Sultan of Zanzibar, duly received his weapons, and that they were *not* made from his meteorite, the story that 'they were of the most superior kind and temper' has a rather amusing sound. It is well known to scientists that meteoric iron quite refuses to yield to successful forging—its grain being too 'short' for a durable cutting edge. The excellency of the weapons returned to the Sultan confirms the suspicion that his messenger pocketed the proceeds of the sale, yet had the grace to visit Sheffield for the swords and simitars. The two masses of Nejed were identical in composition, as they were closely similar in size, weight and general external appearance. When a polished section of this iron is etched with acid or with bromide-water its surface displays excellently the Widmanstätten figures, the straight long beams of Kamacite forming the approximately equilateral triangle pattern according with the octahedral crystallization of the mass.

Mr. Fletcher has analyzed the iron, and has shown its near similarity in composition to the iron of Trenton (Wisconsin), Toluca (Mexico) and Verchne Udinsk (Siberia). The relation of the four irons is as follows:

	Nejed.	Trenton.	Toluca.	V.Udinsk
Iron	91.04	91.03	90.74	91.05
Nickel	7.40	7.20	7.78	8.52
Cobalt	0.66	0.53	0.72	
Copper	trace	trace	0.03	
Phosphorus	0.10	0.14	0.24	trace
Sulphur	trace		0.03	trace
Insol. Residue	0.59	0.45	0.34	0.58
	99.79	99.35	99.88	100.15

This close similarity of composition in masses fallen in widely separated parts of our earth, at different dates, and coming perhaps from heavenly bodies infinitely distant from each other in space, is one of the many wonders revealed by these cosmic messengers. Lockyer has also shown that the spectra of the two meteorites, Nejed and Obernkirchen, closely agree as to both the number and the intensity of the lines. The specific gravity of the Nejed was determined by Fletcher at 7.863. Cohen and Brezina both speak of its very slight *veranderungszone.* This surface decomposition being less than 1 mm. in thickness, together with the general sharpness and brightness of the iron, lends probability to the story of the Arabian that Nejed was seen to fall. Indeed Fletcher says of it in his earliest description, "The mass is thus one of the small group of meteoric irons, numbering at most nine or ten, of which the fall has been actually observed; and of these it is the largest." But in a later paper he expresses doubt as to the fall having been seen. We at least know that it fell in some quite recent period, and at the point where it was found. And Nejed, attractive in its peculiar history, is also interesting as being like Veramin of Persia (described by the writer in the December number of the *American Journal of Science*), one of the isolated, outlying meteorites. The great countries of Arabia and of Persia have each received, so far as recorded, but one of these celestial gifts. India, of almost exactly the area of these two countries combined, has the full number of fifty. The density of population in the Indian peninsula has doubtless something to do with the observing of these falls and the preserving of the stones. But this cannot account for the enormous disparity of the meteoric distribution. Nejed remains a grand and unique representative of isolated individuality.

HENRY A. WARD.

ROCHESTER, N. Y.

PRECAUTION IN THE USE OF GASOLINE.

IN those laboratories where gasoline is in use, it is necessary to observe a certain precaution with regard to the employment of rubber tubing, to which so far as I know, attention has never been directed. This precaution is that tubing which has been in use on burners should not be used afterwards for conducting gases, unless it has been very thoroughly washed out, or left to stand for some time. Serious accidents may result if, for example, a piece of tubing which has been used for some time on a burner, is immediately connected to a gasometer containing oxygen, for transferring that gas to cylinders or flasks for experiments. It would be natural to suppose that in such a case the washing out of the gasoline would be complete enough after one had passed through the tubing a volume of oxygen say two or three times as large as the capacity of the tubing itself. But under certain circumstances this is found to be by no means sufficient, as the following experiment illustrates.

Ten feet of thin-walled gray tubing having an internal diameter of one fourth of an inch, was used on a burner for half an hour, and was from there transferred immediately to a gasometer of oxygen; the gas was then allowed to pass through the tubing and fill over water a cylinder the capacity of which was 560 cc.

As might have been expected the gas so obtained in the cylinder exploded violently. The volume of such a piece of tubing is about 95 cc., and hence the gas drawn off would contain something less than one sixth of the mixed hydrocarbons.

A second cylinder was then drawn off, and when a taper was thrust into it an explosion was produced which was as violent as the first.

The third cylinder also exploded, though less violently; the fourth flashed back slowly to the bottom, and the fifth behaved like pure oxygen.

Thus in this case 2,240 cc. were used to wash out a tube whose volume was less than 100 cc. That is, the contents of the tubing were displaced more than twenty times before the gas was removed.

The experiment obviously points to a solubility of the gas in rubber, and this is not surprising in view of the ready absorption by rubber of the low-boiling paraffin hydrocarbons in the liquid state.

That a certain amount of gasoline is absorbed in rubber may also be shown by passing a piece of rubber tubing up into a tube filled with the gas and inverted over mercury. It is of course to be remembered that the gas supplied by such machines as that in use here (Springfield Gas Machine) consists of a mixture of the vapors of the hydrocarbons with a very considerable proportion of air, so that such absorption experiments as these can only be relative. An evident absorption takes place even with gasoline which does not show any abnormal behavior when conducted through the tubing; but when such behavior was manifested, the absorption was more than doubled.

The danger arising from this source lasts for only a short time after the gasoline tank has been filled; and indeed the results recorded above were obtained only twice, although four attempts were made immediately after the filling of the tank; this irregularity is probably due to the varying demands made upon the gasoline machine at different times.

The rubber tubing employed in the experiments was such as is furnished under the catalogue number 8012 by Messrs. Eimer and Amend. The gasoline was that supplied by the Gilbert and Barker Manufacturing Company; hence it is of normal quality; the phenomenon in question was observed both with the 86° and 90° products (degrees Baumé, equivalent to the specific gravities 0.66 and 0.65).

On the whole these observations point to the conclusion that gasoline of the kind described contains a small amount of more volatile components, which are given off mainly at first, and being perhaps more soluble in rubber than those which come over later, cause the abnormal behavior above described.

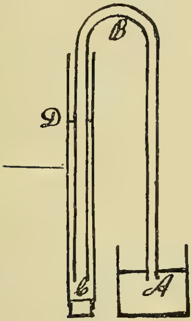
It would be interesting to know whether others who use gasoline have had occasion to notice this peculiarity.

A. P. Saunders.
Hamilton College, Clinton, N. Y.

ON THE SIPHON.

The writer wishes to call attention to an error that has crept into the text-books on general physics, written for high school and university classes. Most of the books either state explicitly that a siphon will not work if the shorter of its two legs is longer than the column of liquid that would be supported by the air pressure, or else give explanations of the siphon, from which this follows as a legitimate conclusion. As a matter of fact, a siphon can be made to work and draw the liquid to a height considerably greater than that representing atmospheric pressure.

The writer usually illustrates this fact in his lectures by means of the following simple experiment: Let *ABC* in the figure be a glass siphon tube, both legs of which are 10 cm. or 15 cm. longer than the barometric column. The bore of the tube should be small (about $\frac{1}{10}$ sq. mm.) to work well. Let one of the legs, *BC*, dip down into a larger tube *CD*, partly filled to *D* with mercury. Fill *ABC* with mercury, and start the siphon drawing mercury from *C* over to *A* in the usual way. In order to start the siphon the vertical height of *B* above the surface *D* of the mercury should be less than the length of a mercury barometer column, but as the flow continues, the mercury surface descends and keeps on descending until its vertical distance below *C* is considerably greater than this length.



To make this experiment work sufficiently well for demonstration purposes, excessive care in purifying the mercury and cleaning the glass is not necessary. Boiling the mercury in the actual tubes used, for instance, is superfluous. With ordinary redistilled commercial mercury and tubes cleaned with alcohol the writer has made the siphon work to a height of 70 cm. As the altitude of the University laboratory, where the experiment was performed, is a little over one mile, and the barometer pressure, therefore, only about 61 cm., this means that the siphon worked 9 cm. above the barometric height.

The most plausible explanation of the above fact is that the atmospheric pressure is not the only force pushing the mercury up the shorter leg. It is drawn up partly by the cohesive attraction of parts of the mercury for each other, and the column is kept from dwindling by the adhesive force exerted by the sides of the tube on the mercury.

It follows from the above that if a mercury siphon is placed under the receiver of an air pump, it can be made to work over a height of several centimeters, even though the air pressure is reduced to only a few millimeters. This experiment also has been shown to the writer's students. The apparatus was similar to that described above, except that the tubes were much shorter.

WILLIAM DUANE.
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FOSSIL SHELLS OF THE JOHN DAY REGION.

SINCE the publication about a year ago* of my paper on the 'Fossil Land Shells of the John Day Region,' etc., I have received from Professor John C. Merriam, of the University of California, a small collection of molluscan remains obtained by him in the same general locality. Professor Merriam's collection includes examples of the several species of land shells heretofore described,† namely, *Epiphragmophora fidelis anticedens, Polygyra Dalli, Ammonitella Yatesi præcursor* and *Pyramidula perspectiva simillima.* Of these four species there are numerous specimens and fragments. Dr. White's *Unio Condoni* apparently escaped detection. The foregoing represent all of the molluscan forms thus far reported from the John Day beds. Dr. White received his material from the late Professor E. D. Cope and Professor Thomas Condon, of the University of Oregon. Cope's specimens were obtained by Mr. Jacob L. Wortman, of the Army Medical Museum. These two collections included the same species.

Professor Merriam has made some interesting additions to the above brief list which are described below.

HELIX (EPIPHRAGMOPHORA?) DUBIOSA NOM. PROV.

Shell orbicular, flattened, discoidal, periphery angulated or obtusely carinated; whorls

* *Proc. Washington Acad. Science*, Vol. II., Dec. 28, 1900, pp. 651–658, pl. XXXV.

† Vide Dr. Charles A. White's paper 'On Marine Eocene, Fresh Water Miocene and other Fossil Mollusca of Western North America'; Bulletin No. 18, U. S. Geol. Survey, Washington, 1885, with two plates.

six or more, deeply sutured and exhibiting strong growth striæ. Apex whorls closely and slightly pitted. Aperture and umbilical region covered by a portion of the matrix in which the shell was imbedded.

Diameter (maximum), 24 mm., probably 26 to 26½ mm. when perfect. Elevation, about 10 mm. A sufficient portion of the shelly substance intact admits of the above description. Number of specimens, six; of these the individual described is the largest and most perfect. The smaller examples consist mainly of the upper whorls.

With more and better material it is quite probable the foregoing might prove to be an angulated, dwarfed, depressed aspect of the living *fidelis,* or *mormonum;* it also suggests the form known as *Hillebrandi.* Nearly all of the material is in a very unsatisfactory condition, with no color indications to assist in determination. While for these reasons the conclusions may be regarded as more or less arbitrary, the general character and relationship is believed to be fairly well pointed out.

PYRAMIDULA LECONTEI N. S.

Shell small, orbicularly depressed, widely and deeply umbilicated; whorls four and a half to five, rounded, closely and conspicuously ribbed except on the apex, which is nearly smooth; the ribbing extending into the umbilical cavity; the grooves between the ribs nearly as wide as the ribs are thick; the suture deep; aperture nearly circular or rounded lunate; edge of lip simple. Diameter (maximum), 8½ mm. Elevation, nearly 5 mm. A single example; the last whorl has been broken back somewhat; the maximum diameter was probably 9 to 9½ mm. The specimen appears to be scarcely mature. The number, prominence and regularity of the ribs make this a very pretty shell. The general facies suggests relationship with the extraordinary group of helicoid forms that are so widely distributed throughout the vast area denominated by Mr. W. G. Binney* the 'Central Province,' and listed by Dr. Pilsbry in his recent catalogue, as number 340† (*P. strigosa* and numerous races or varieties). A comparison of *P. LeContei* kindly made for me by Professor Dall, with the large series of the *strigosa* group in the National Museum, determines it, as he says, to be 'different from anything we have in the collection.'

In memory of the late Professor Joseph Le Conte, I have attached his name to the above form.

In addition to the species herein described, the material submitted to me by Professor Merriam included a small globose form about the size of a small pea; there are several examples, so disguised by adherent particles of matrix as to make it doubtful whether they belong to terrestrial or aquatic groups, with a presumption in favor of the first.

Partially exposed in portions of a fine compressed sediment of lacustrine origin are several casts of a very large *Limnœa,* suggestive in a general way of the circumboreal *L. stagnalis,* but so much distorted as to preclude a more definite description. For convenience this may be known provisionally as *L. maxima.*

Professor Merriam has now in preparation a paper on the paleontology of the John Day region, which will contain in detail the special data relating to the occurrence of the various forms above referred to as well as figures of the species I have described.

Robt. E. C. Stearns.

* 'Manual of American Land Shells,' Bull. 18, U. S. National Museum.

† 'Classified Catalogue of Land Shells of North America,' etc., Philadelphia, April, 1898.

CURRENT NOTES ON PHYSIOGRAPHY.

THE ISTHMUS OF PANAMA.

An essay on the 'Geology of the Central Portion of the Isthmus of Panama,' by Hershey (*Bull. Dept. Geol. Univ. Cal.,* II., 1901, 231–267), includes an account of the surface features in terms of the two chief cycles of denudation that have had effect there. The axial Cordillera de Veraguas, trending east and west, is described as a dissected plateau whose general surface, once a lowland of degradation, consisting in part of syenite and intrusive volcanic rocks, is now raised to an altitude of 3,000 feet. The valleys in it are deep, narrow, and steep-sided. Eliminating them, the district would be a high plateau with a width of 20 or 25 miles, arched a little along an east-west medial line, but otherwise remarkably even. The ridges often have nearly level crest-lines for several miles, and rise to similar altitudes; and there are some extended flats at the height of the ridge tops. Southward from the mountains there is a lower and younger and much better preserved peneplain, uplifted a few hundred feet, sloping gently toward the sea and sharply trenched by young valleys 'the most beautiful and perfectly base-leveled land' that the writer has seen. The interfluves are very slightly arched and are remarkable for their long gentle slopes. Many low monadnocks rise above the plain, and these, together with a 10- or 20-mile belt of irregular ridges and peaks bordering the mountains, are taken to be the remnants of the older peneplain, here less preserved than in the harder rocks of the Cordillera. The border of the younger peneplain, determined by the ending of its gently undulating strata, is followed by a young coastal plain, trenched like the peneplain by narrow valleys and cliffed along the shore; here the interfluves are flat, instead of being gently arched as further inland. The coastal plain, as an area of marine deposition, is the equivalent of the younger peneplain as an area of subaerial degradation. On the northern side of the isthmus, a narrow, dissected peneplain slopes gently from the Cordillera to the seacoast. This plain bears auriferous gravels near the mountain base. The slopes of the two younger peneplains, north and south of the Cordillera, and the greater height that is believed to have been gained by the older peneplain along the mountain axis, suggest a repeated up-arching of the isthmus along an east-west line. A recent depression has occurred, especially noticeable along the southern coast, where there are several good examples of partly drowned valleys.

THE GRECIAN ARCHIPELAGO.

PHILIPPSON'S latest studies in classic lands concern the Cyclades or southern island group of the Grecian archipelago ('Beitr. zur Kenntniss der griech. Inselwelt,' *Pet. Mitt. Ergänzungsheft*, 134, 1901, 172 pp., 4 maps). The islands are, in the most general statement, the remains of an old-mountain region (Rumpfgebirge) reduced to moderate but not faint relief, then elevated and much dissected by streams and waves during slow depression, finally more rapidly submerged and again vigorously attacked by the sea. The geological structure is irregular and not clearly related to the distribution of the individual islands. The old-mountain uplands are best preserved where the rocks are somewhat uniformly resistant, as on Andros; elsewhere, variety of structure leads to variety of form, Naxos being of most rugged relief. The valleys are rather sharply incised beneath the uplands; the author parenthetically notes that they would be called 'young' by American morphologists. They represent the headwater parts of what was once a much more extensive drainage system, developed while the land stood higher than at present. During that time the sea is believed to have actively abraded the coast, producing a platform of tolerably even surface from three to fifteen miles wide, with greater breadth on the exposed than on the protected sides of the islands. The depth of the platform decreases from about 200 met. at its outer border to about 80 or 50 met. near the islands; and hence a slow depression is inferred during abrasion. Then came the more rapid submergence, bringing the sea about to its present level on the steep coast that had previously been cut around the remnant islands, and transforming the valleys into bays whose depth corresponds to that of the inner border of the submerged platform. The exposed parts of the present shore line are usually bold and ragged. Few of the islands have lowland plains, those on the western side of Naxos being the largest.

In not making explicit mention of the work of subaerial erosion during the inferred abrasion of the now submerged platform, Philippson's summary may give the impression that the greater part of the old-mountain uplands were consumed by the sea. It is probable, however, that many deep and broad valleys were eroded in the original uplands by streams, while the outer border of the platform was cut away by the waves; and that the further abrasion by the sea was aided not only by slow depression but also by the work already then accomplished by subaerial erosion. Only by supposing an extensive system of open valleys to have been developed during the earlier advance of wave work on the retreating coast can satisfactory explanation be given for the scattered arrangement of the remnant islands on the abraded platform.

THE SOUTHERN URALS.

The excursion of the Russian geological congress turned attention to the Urals as an example of an uplifted and dissected peneplain. Further information on this subject is found in some 'Topographic notes on the Ural Mountains,' by Purington (*Bull. Amer. Geogr. Soc.*, XXXIII., 1901, 103–111). The southern extension of this old chain, where the structure is as greatly disordered as elsewhere, is for the most part a gently undulating plain, the Orenburg steppe, hundreds of miles in extent. Its surface is compared to that of a calm sea, swept by huge, flat, crossing swells, 100 or 200 feet high and from two to four miles from crest to crest. The general turf cover of the nearly treeless plain is frequently broken by low reefs of quartzitic schists, traceable for long distances, and thus revealing something of the underground structure. Some of the more decomposable schists are weathered so deeply that mine shafts have been dug 100 feet deep before blasting was necessary. Water-worn gold-bearing gravels are abundant on the undulating plain, but are frequently too far from the streams for profitable washing. Low monadnocks of the more resistant rocks occur in the region of the steppe; further north in the forested Urals the higher extension of the same peneplain is dominated by dome-shaped monadnocks, rising 3,000 and 4,000 feet over the uplands. The rivers of the steppe have now eroded broad and shallow valleys from 50 to 200 feet deep; the sides of the valleys are well defined where they rise to the upland, whose borders are dissected by ravines for a few hundred feet. The valley floors are sheeted with gravels in which the rivers meander freely.

W. M. Davis.

THE STRECKER COLLECTION OF LEPIDOPTERA AND THE AMERICAN MUSEUM OF NATURAL HISTORY.

Since the death of Dr. Herman Strecker, many representatives of large museums have visited his former home in Reading, Pennsylvania, and commendable zeal has been displayed in their efforts to secure the Strecker collection of lepidoptera for their respective institutions. The heirs, however, have insisted that no deviation would be made from the original valuation placed upon the collection by Dr. Strecker, namely $20,000. The Right Reverend Dean Hoffman has authorized the American Museum to purchase the collection. This is not the first time that Dean Hoffman has benefited the people of New York by gifts of like character, and the silent appreciation of the thousands that visit the superb exhibition of butterflies and moths which his generosity has made possible is itself a testimonial of public gratitude.

The growth of the Department of Entomology within the last few years has been phenomenal. In 1890 Mrs. M. S. Elliot donated the 'Elliot Collection,' consisting of six thousand local specimens, all reared from caterpillars, and consequently as nearly absolutely perfect as specimens can be—butterflies that are captured in the field are almost invariably injured. In 1892 friends of the Museum contributed some $15,000 toward the purchase of the 'Harry Edwards Collection.' This was a general collection of insects, but contained some forty to fifty thousand butterflies and moths from various parts of the world; among these were some three hundred which were absolutely new to science. For a long time this has remained the principal part of the Museum collection. In 1891 a collection of insects numbering some ten thousand, and containing at least three thousand North American Lepidoptera, was donated by Mr. James Angus. Mr. Angus had made a specialty of one genus of moths, the *Catocala*, and in this one genus alone he had upwards of fifteen hundred specimens. In 1897 Mr. William Schaus, then of New York, but now of England, donated a remarkably complete collection of Old World Lepidoptera, numbering some five thousand specimens, all authoritatively named, and many representing most remote localities.

The arrival of the Strecker material will increase the Museum collections by fully one hundred thousand specimens, among which are several hundred 'types.' Mr. William Beutenmüller, the curator of entomology, will personally attend to the details of transportation. The Museum will also receive the 'Strecker Library.'

THE MISSOURI BOTANICAL GARDEN.

FROM advance sheets of the administrative report of the Garden for 1901, it appears that during the past year $44,409 was spent on the maintenance and improvement of the establishment, $5,287.60 less than the net income for the year after providing for publications and certain fixed events designated in Henry Shaw's will, the total gross receipts being $125,690.73.

91,262 persons visited the Garden, about 45 per cent. of this number on the first Sunday afternoon each in June and September, the only two holidays on which the Garden can be opened to the public.

The collection of living plants, which in 1900 contained 9,194 species or varieties, has been increased to 9,967. Nearly 3,000 surplus plants were distributed to hospitals and schools. Exchange relations were maintained with other botanical establishments, and in addition to what was derived from these sources the living collections were increased by an expenditure of $2,829.61.

16,256 sheets of specimens were incorporated in the herbarium ,on which $1,175.39 was spent, and the herbarium is stated to consist now of about 365,000 specimens, valued at $54,743.00.

$2,688.71 was spent on the library, to which 929 books and 254 pamphlets were added, and the library now contains about 36,000 books and pamphlets, valued at $60,305.00, in addition to which there are about 275,500 index cards.

The extent of the exchange relations of the Garden is shown by the Director's statement that 1,184 serial publications are received at the library, of which 1,083 are received in exchange for the Reports of the Garden.

THE NATIONAL GEOGRAPHIC SOCIETY.

SEVERAL announcements of plans and progress are made by the National Geographic Society. A handsome building, costing $50,000, is being erected for the Society and as a memorial to its first President, Hon. Gardiner Greene Hubbard. The building is located on the corner of M and 16th Streets, in the central part of the city.

The annual meeting of the Society was held on the 10th of January, Alexander Graham Bell in the chair. The membership of the Society is now about 2,700, representing every State in the Union. The following directors were elected for three years:

Alexander Graham Bell, General A. W. Greely, chief signal officer of the War Department; Henry Gannett, chief geographer of the U. S. Geological Survey; Angelo Heilprin, Academy of Natural Sciences, Philadelphia; Gifford Pinchot, forester of the U. S. Government; O. H. Tittmann, director of the Coast and Geodetic Survey; W J McGee, ethnologist in charge of the Bureau of American Ethnology, and Russell Hinman, New York City.

The National Geographic Society is already forming plans for the great International Congress of Geographers which will be held under its auspices in Washington in 1904. It is the first time the Congress has met in the Western Hemisphere. These geographic Congresses are of international importance and it is expected that representatives from all parts of the world will attend.

SCIENTIFIC NOTES AND NEWS.

AT the meeting of the Paris Academy of Sciences on January 6, M. Bouquet de la Grye, the engineer, succeeded to the presidency. M. Albert Gaudry, the paleontologist, was elected vice-president, and will be elected president next year.

THE Lavoisier medal of the Paris Academy of Sciences has been awarded to Dr. Emil Fischer, professor of chemistry in the University of Berlin.

Dr. John C. Smock, for many years state geologist of New Jersey, has been given the degree of LL.D. by Rutgers College.

Mr. William Marconi was entertained by the American Institute of Electrical Engineers on January 15.

Dr. T. C. Chamberlin, professor of geology at the University of Chicago, has been re-elected president of the Chicago Academy of Sciences.

Lord Kelvin expects to visit the United States at the end of next month.

Dr. B. O. Peirce, Hollis professor of mathematics and natural philosophy at Harvard University, has returned from Europe. He expects to resume the duties of his professorship at the beginning of next year.

Professor C. H. Eigenmann has leave of absence during March, and will visit some of the caves of western Cuba to secure a series of the cave fauna and especially specimens of the cave fishes *Stygicola* and *Lucifuga*.

Professor Mortimer E. Cooley, head of the department of mechanical engineering in the University of Michigan, was nominated for the presidency of the Michigan Engineering Society, at the session of January 8, held at Grand Rapids.

Professor William Hallock, of Columbia University, has been elected president of the New York State Teachers' Science Association.

Professor Kossel, who holds the chair of physiology at Heidelberg, has been elected a member of the Stockholm Academy of Sciences.

Professor Sadebeck, director of the Botanical Museum at Hamburg, has retired.

The Colonial Museum at Harlem has arranged to commemorate, on June 15, the two-hundredth anniversary of the death of the naturalist, Rumphius, who for forty years carried on work in botany and other branches of natural history on the Island Amboina, one of the Molucca Islands. A medal will be struck which can be obtained, silver or bronze, and a memorial book will be issued.

A committee has been formed at Cromarty, the birthplace of Hugh Miller, the purposes of which are to erect a museum and library to celebrate the centenary of Hugh Miller's birth.

Dr. Alpheus Hyatt, curator of the Boston Society of Natural History, assistant in invertebrate paleontology in the Harvard Museum of Comparative Zoology and professor of biology and zoology in Boston University, one of the most eminent of American naturalists, died suddenly from apoplexy at Cambridge on January 15, aged sixty-three years.

Mr. J. F. Ward, a well-known engineer, died on January 16, aged seventy-one years.

T. T. T. Thorell, a distinguished arachnologist, died at Helsingborg, Sweden, on December 23, in his seventy-second year.

Dr. C. P. Tiele, professor of comparative religions at the University at Leyden, died on January 13 at the age of seventy-one years.

Dr. Hugo von Perger, professor of applied chemistry in the Technological Institute in Vienna, has died at the age of fifty-nine years.

Mr. James P. Shipman, who published a number of papers on the geology and paleontology of the region about Nottingham, recently died at the age of fifty-three years.

The position of chief mechanician in the National Bureau of Standards at a salary of $1,400 will be filled by civil service examination on February 26.

We learn from *Nature* that Dr. W. A. Herdman, F.R.S., professor of zoology at University College, Liverpool, sailed for Ceylon on December 26, 1901, to undertake for the government an investigation of the pearl oyster fisheries of the Gulf of Manaar. He is accompanied by an assistant, and in Ceylon the inspector of the fisheries and his staff will co-operate and provide boats and divers. A suitable steamer for dredging and trawling will be placed at Professor Herdman's disposal by the Government of Ceylon; and the necessary gear and apparatus for collecting and observational work, and for biological experiments, have been sent out in advance. Professor Herdman has arranged to take samples of the plankton throughout the voyage to Ceylon, and to launch current-floats at particular parts of the course.

REUTER'S representative has had an interview with Captain J. E. Bernier, the Canadian explorer, who is organizing an arctic expedition. Since his last visit to England, when he lectured before the Colonial Institute, he has been in Canada, where he has secured the active support and cooperation of the Dominion Government for his scheme. Captain Bernier, who is devoting his services gratuitously, estimates the cost of his expedition at £30,000. Of this he has already secured £20,000, including a contribution of £1,250 from the Dominion Government, and £1,000 from Lord Strathcona, besides large donations from Canadian ministers, members of Parliament, merchants and others. Captain Bernier is now in London with the object of procuring from English subscribers the balance of £10,000 necessary for his scheme.

THROUGH the kindness of Mr. B. Talbot B. Hyde, there was an exhibition of the weaving of Navajo blankets and of beaten silver ornaments by Navajo Indians from New Mexico in the Educational Museum of Teachers College, Columbia University, on January 13.

THE Montreal correspondent of the New York *Evening Post* reports that the Hon. E. H. Monson, of Ottawa, has given a sum of money to the medical faculty for researches into possible cures for tuberculosis. They are to be carried on by Dr. A. G. Nicholls, lecturer in pathology, under the direction of Dr. J. G. Adami, professor of pathology.

A BACTERIOLOGICAL institute has been established at Davos, Switzerland.

THE trustees of the estate of the late Nathan Haskell Dole have given $100,000 for the Boston Public Library.

THE membership of the New York Zoological Society, according to the report of the executive committee, submitted at the sixth annual meeting on Jan. 14, is now 1,063, and is steadily increasing. The total attendance at the park in the past year was 527,145, the greatest attendance on one day being 20,206, on Sunday, August 24. The important work done included the erection of the Primates' House, at a cost of $64,160; the beginning of the Lion House, to cost, when complete, about $150,000; the extension of the sewer and water systems of the park, at a cost of $10,406, and the development of Mountain Sheep Hill and enclosures, at a cost of $2,500. Director Hornaday reported that the Zoological Park now contains 1,674 live exhibits, of which 416 are mammals, 659 birds and 599 reptiles.

A PETITION has been presented to King Edward for the incorporation of the British Academy for the Promotion of Historical, Philosophical and Philological Studies, and has been referred to a committee of Lords in Council.

REPRESENTATIVE SOUTHARD, of Ohio, chairman of the House Committee on Coinage, has sent invitations to a number of the chief manufacturers, merchants and others engaged in mercantile pursuits, to appear before the Coinage Committee on February 6 at a hearing on the bill for the adoption of the metric system of weights and measures.

THE Treasury agents state that during the past season an epidemic has prevailed among the murres, of the Pribilof Islands, and that the birds, which are found there in vast numbers, have perished by thousands. The first intimation of disease was the presence of birds about the village of St. Paul, close in shore, so weak that they were readily taken by the children. Later dead birds washed ashore in such numbers that 212 were counted in 150 yards, while steamers from St. Michaels reported passing through large quantities of dead birds. This recalls the epidemic which has twice prevailed among the cormorants of the Commander Islands, greatly reducing their numbers.

THE following lectures before the Franklin Institute, of Philadelphia, are announced:

January 17—'The Austrian and Italian Tyrol': DR. CHARLES L. MITCHELL, Philadelphia.

January 24—'The Aborigines of the Arid Region': PROFESSOR W J MCGEE, Bureau of American Ethnology, Washington, D. C.

January 31—'Porto Rico': MAJOR GEO. G. GROFF, late Superintendent of Public Instruction in Porto Rico, Lewisburgh, Pa.

February 7—'The Gases of the Atmosphere': Dr. H. F. Keller, Central High School, Philadelphia.

February 14—'The Canyons and Sierras of the Great Southwest': Mr. Robert T. Hill, U. S. Geological Survey, Washington, D. C.

We have already noted the bequest to the Natural History Museum, London, by Mr. Philip Crowley, of the valuable collection of birds' eggs. In accordance with the terms of the will the trustees were permitted to take four clutches of eggs of each species, or more, should any species be useful or interesting by reason of variety or locality. The selection, the London *Times* states, has recently been completed, with the result that 15,200 eggs of birds have been added to the series of eggs preserved in the zoological department of the museum. The Crowley bequest falls only a few specimens short of the series of Indian birds' eggs presented to the nation by Mr. Allan Hume in 1885. Mr. Crowley began to form his collection more than forty years ago, one of his great acquisitions being Canon Tristram's fine collection, which contained an egg of the great auk and one of the Labrador duck. These two rare eggs now pass into the possession of the national museum—a matter of some satisfaction, as hitherto the great auk has been represented in Cromwell Road by two very poor and broken specimens. The Crowley great auk's egg was bought in 1853 for £35. A very fine specimen which came into the market last year realized 315 guineas. One of the most interesting features of the Crowley collection is the remarkable series of cuckoo's eggs with those of the foster-parents. Of these there are as many as 87 different clutches, while 37 species are represented. As regards Australian birds the museum series has hitherto been markedly deficient, and as the Crowley collection was particularly rich in the eggs of that continent the increase in this respect is very appreciable. From a rough estimate it appears that the series of eggs in the Natural History Museum has been increased by nearly a third in respect of numbers, and as regards the species represented, by at least 15 per cent. Mr. Crowley also left the museum the pick of his valuable collection of exotic butterflies. The number of specimens retained for the museum was nearly 27,000, representing about 9,900 species. The selection made will enable the museum authorities to fill important gaps in the collection, which was most deficient in examples from the localities in which the Crowley collection was especially rich—namely, West Africa, the Moluccas, and Central and Southern America.

UNIVERSITY AND EDUCATIONAL NEWS.

Among the gifts recently received by the University of Pennsylvania are: Mr. William Ivins, $2,500 for the new Medical Laboratories; Mr. James Hay, $2,500 for the Engineering Departments; Mr. Ralph C. Stewart, '99 C. and '02 L., $5,000 towards the new building of the Department of Law.

General Isaac J. Wistar has paid $12,000 for a triangular lot of ground at Thirty-seventh Street and Woodland Avenue, on which a city police station now stands. The land will be presented to the University of Pennsylvania, so that the Wistar Institute of Anatomy and Biology, which adjoins on the east, and which is also a gift of General Wistar to the University, may be enlarged.

Mr. John D. Rockefeller has promised to double all sums of money given to Vassar College up to $200,000, between this time and June, 1902.

Dr. Henry Hopkins, a congregational clergyman, has been elected president of Williams College. He is the son of Mark Hopkins, who was president of the college from 1836 to 1872.

Dr. Samuel Weir, formerly of New York University, has accepted a lectureship in pedagogy at the University of Cincinnati, for the remainder of this year.

Dr. Hansdorff, docent in astronomy and mathematics in the University at Leipzig, has been appointed to an assistant professorship. Dr. K. Zeissig has been appointed assistant professor of physics at the Technical Institute at Darmstadt, and Dr. Parmentier assistant professor of botany at the University of Besançon.

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 31, 1902.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*THE DEVELOPMENT OF CHEMISTRY.**

THE American Chemical Society exists for the advancement of chemical science, and the betterment of the chemical profession. Every member of it is supposed to contribute his share of thought and energy to the accomplishment of these ends; and so its work is prosecuted along many lines of activity. During the past ten years the growth of the Society has been most remarkable, and the diversity of its interests is well shown in the pages of its *Journal.* The once doubtful experiment of organization has justified itself by success, and there are no longer any apprehensions as to the future. The Society now stands before the world well established, well recognized, active and vigorous; its days of weakness and danger are over; we can look forward with confidence to greater prosperity, to larger growth, to steadily increasing usefulness. All chemistry is our province, whether it be organic, inorganic, theoretical, physical or applied; and the narrowness of specialism finds its best antidote in the varied interests of our meetings. To promote science and to uphold the dignity of our common profession are the objects which bind us together.

Optimism is a good thing, but it needs to

* Presidential address delivered at the Philadelphia meeting of the American Chemical Society, December 30, 1901.

be tempered by reason. Hopefulness and enthusiasm are fine qualities, but the restraint of common sense should keep them within bounds. Too much complacency is dangerous, and on occasions like this we may well pause in our gratulations over past achievements, to ask ourselves whither we are tending. As chemists, we owe something to the science which we represent, and the debt is one which can never be discharged absolutely. That we have done much is evidence that we can and should do more; as a society and as individuals we may well look about us and strive to see which way the path of duty lies. We cannot appraise the future, but we must help to make it. Only by acting with intelligent forethought can we hope to advance creditably.

Retrospection is the one safe basis for prophecy. The history of science is full of suggestions for the days to come, and even if we do no more than to avoid the repetition of mistakes, we shall gain much from the study. Great as the past has been, we can make sure of something better still, looking confidently forward to more perfect knowledge, to larger opportunities for research and to wider recognition in the republic of learning. Let us see how chemistry has developed hitherto, and how we can improve her present condition.

A little over a century ago chemistry was hardly more than an empirical art—a minor department in the broad field of natural philosophy. There were no chemists in the professional sense of the term, and no laboratories worthy of the name; that is, no buildings were planned and erected for chemical purposes alone; but chemical investigations were conducted in any room which happened to be available, with a disregard for convenience which would be intolerable to-day. Even at a later period the marvelous researches of Berzelius were performed in a laboratory which was essentially a kitchen. If we use the word in its true sense, the earlier chemists were amateurs; that is to say, men who labored for the love of truth and without ulterior professional motives. Priestley was a clergyman, who regarded his voluminous theological writings as more important than his contributions to science. Scheele was an apothecary; Lavoisier was a public official with multifarious duties; Dalton was a schoolmaster and arithmetician. Before these men and their contemporaries, a vast unexplored territory was outspread; and no one could suspect what hidden riches might lie beneath its surface. Lavoisier, with his emphasis upon quantitative methods; Dalton, with the atomic theory; Davy, the discoverer and definer of elements; and Berzelius, with his genius for system and his untiring industry in the accumulation of details, opened the main roads into the new empire. Specialism in chemistry was practically unknown; all portions of its domain seemed to be equally inviting; but inorganic problems were perhaps the most obvious, and, being easiest to grasp, received the greater share of attention.

There were, from the beginning, two great stimuli to chemical research; the intellectual interest of the problems to be solved, and the practical utility of many discoveries. Both forces were essential to the rapid development of our science; neither one alone would have been adequately effective. Economic considerations, taken by themselves, help but little towards the symmetrical organization of scientific knowledge, for the practical man has usually a limited, although very direct, purpose in view, and may not wander far from his main issue. On the other hand, the purely scientific investigator can rarely exercise his full powers without a certain measure of popular support and encouragement, to which the expectation of usefulness contributes. That discovery must precede application is obvious; that systematic knowledge outranks empiricism is also clearly true; but theory and practice react upon each other, and it is only when they work harmoniously side by side that the best results are attainable. The purist in science too often overlooks this fact, and fails to recognize his enormous debt to industry. The commercial demand for chemical data was an important factor in the establishment of our profession, and from it we derive a large part of our resources. At bottom, however, the demand is essentially selfish; and the manufacturer who seeks chemical aid, nay, even the technical chemist himself, is not uncommonly forgetful of his obligations to pure research. Every chemical occupation is based upon discoveries which were made without thought of material profit, and which sprang from investigations undertaken in the interests of truth alone. Even theory, which the ignorant worker affects to despise, has its place in the economic world, and the indebtedness of the coal-tar industry to Kekulé can hardly be overestimated. Without theory science is impossible; we should have, instead, only a chaotic anarchy of disconnected facts, a body without a soul. Theory is to science what discipline is to an army; it implies system, method and the intelligent direction of affairs; it is the coordination of knowledge, through which the experience of others becomes best available to us. The victories of research are rarely accidental; if they were, then the untrained tyro would have an equal chance of success with the greatest masters. Among ourselves, these considerations may be commonplace, but they are opposed by certain popular misconceptions which hinder our advancement and work mischief to our cause. *Cui bono* is the one question which science cannot ask.

Four agencies have been chiefly instrumental in building up the chemical structure of to-day, namely, private enterprise, the commercial demand, governmental requirements, and the extension of scientific teaching in the universities. Under the first of these headings the foundations of chemistry were laid, and the researches of Cavendish upon the composition of the atmosphere, may be taken as types of the class. Unfortunately, however, the men who combine the requisites of wealth, leisure, the inclination and the ability for scientific investigation are few in number, and the output of their labors is relatively small. Still, we must admit that the work so accomplished is often far above the average in quality, and that if it were to cease, our science would be much the poorer. Its motive is always high, and unaffected by any annoying pressure from necessity; its objects are purely scientific.

Seen from the commercial side, chemistry presents quite another aspect. Questions of utility are now paramount, and the advancement of science as such has become a secondary affair. The manufacturer seeks to improve his products or to cheapen his processes, and calls for information which shall enable him to do so; specific industrial problems require immediate attention, and each one is taken by itself, regardless of its broader philosophical bearings. From these conditions a certain narrowness must follow; no time can be wasted over considerations not directly related to the matters in hand, for the success or failure of a great enterprise may depend upon the quickness with which the obviously essential work is done. As against this urgency of demand, no just criticism can be offered; we may only ask that it shall be reasonable, and that science shall be treated less as a servant, and more as a faithful ally. The commercial chemist owes something to his profession, as well as to his employer; and his industrial duties ought not to be incompatible with his responsibilities as a scientific man. The education of the manufacturer is one of the functions which he has to perform, and it is one which is not always easy of accomplishment. Two points of view have to be reconciled; self-interest is on the one side, the benefit of science on the other.

Several difficulties beset the pathway of applied science, and interfere with the work of its practitioners. The limitations of the field have already been suggested; but a more serious obstacle to progress is found in the secretiveness of the employer. The industrial chemist can not publish his researches, or at best can publish little; he therefore fails to receive before the world the credit which is his due, and science as a whole is the loser. A secret process, an unpublished investigation, adds nothing to the sum of human knowledge, and it represents a policy which is both short-sighted and unwise. It often covers ground which has been well covered before, and in that case it stands for misdirected effort, for wasted energy. I have seen, under the seal of confidence, a 'secret process' which had been in print for twenty years; its too practical inventor, ignorant of the literature of his subject, had worked out his methods independently; had he consulted others, he might have saved both expense and time. On still broader grounds I believe we may claim that the publicity of science is more economical than the current exclusiveness. Where several competing establishments produce the same class of goods, each one tries to hide its workings from the others. Each, therefore, gains only that new knowledge which it can develop by itself, whereas with greater wisdom it might profit by the experience of all. Secrets will leak out, in spite of precautions; a full interchange of thought merely anticipates the danger, and at last the manufacturer may find that instead of suffering loss, he has really received much for little. Possibly the combination of industries under the so-called 'trusts' may act favorably upon scientific research, for when rivalry ceases, the incentive to secrecy disappears also.

If we study the reaction between science and industry at all closely, I think we shall find that an economic revolution of remarkable importance is well under way. Like all the greater social movements, it is going on quietly, without noise or bluster, but it is nevertheless far-reaching in its effects. Manufacturing, once a matter of empirical judgment and individual skill, is more and more becoming an aggregation of scientific processes, a system in which accurate quantitative methods are replacing the old rules of thumb. Exact weight and measure are taking the place of guesswork, and by their means waste is diminished and economy of production is insured. I can remember the day when few establishments in America gave regular employment to chemists; now laboratories are maintained in connection with nearly all productive enterprises, and the demand for scientific service, which was formerly sporadic, has become well-nigh universal. A railway system, making contracts for supplies, does so upon the basis of chemical reports; and the work is performed in its own offices by experts who are permanently retained. In the management of an iron furnace, ore, flux, fuel and product are analyzed from day to day, by methods of amazing rapidity and considerable exactness. Fertilizers are sold upon chemical certificate after preparation under chemical rules; sugar is refined by chemical processes, and taxed according to chemical standards; medicine is enriched by new remedies of chemical origin; in short, our science touches every productive industry at many points, and aids in its transformation. Metallurgy is becoming more and more a chemical art; photography, a modern science, rests upon chemical foundations; with the aid of the electric furnace new chemical industries are springing into existence; and every one of these agencies reacts upon the chemist, by increasing the demand for his services and his wares. In Germany this development of applied science has gone the farthest; and in that country a single establishment may employ from fifty to more than a hundred chemists in its regular work. Some of these men are analysts merely, but others are engaged in systematic research, which has both science and industry in view. This appreciation of research as such is something to which few of our American manufacturers have attained; and it marks the highest step yet taken in the line of industrial progress. The modern era began when hand labor, which means individualism, gave way to machinery; but the machine is a symbol of organized intellectual power, and science is the bed-rock of its foundation. Chance and supposition are out of place in the industrial world of to-day.

Turning now to the governmental side of science, we find that the services of the chemist are everywhere in demand. Every civilized government now maintains chemical laboratories, and for purposes of the most varied kind. The accuracy of the coinage is determined by the assayer; supplies for public use are tested by analytical methods; taxes are assessed in terms which need chemical interpretation; the armor of the battleship and the explosive of the torpedo depend for their efficiency upon the skill with which our work is done. The sanitation of cities; their water supply; the disposal of sewage; the effectiveness of antiseptics; the quality of gas for lighting or of asphalt for paving; the warfare against the adulteration of food—all of these questions are essentially chemical in character, and are, or should be, settled in the official laboratory. The aggregate of this work is something enormous; and yet, like commercial chemistry, it has utility, not science, in view. Science may advance because of it, but that is not the main purpose; the application of existing knowledge to public uses, and the creation of new knowledge are two distinct things. Here again chemistry is a servant, nothing more.

Throughout the scientific bureaus of the government this secondary character of chemistry appears. In the Geological Survey it is an aid to geology; in the Department of Agriculture, agriculture is to be advanced; in the medical service of the army or the navy, the interests of medicine come first. Chemistry for its own sake has as yet little or no governmental support; astronomy is encouraged, geology receives assistance, the biological sciences are given opportunities for growth; but our profession is merely utilized, without thought of its significance, its laborers being too often overworked and underpaid.

In an incidental way, however, the governmental laboratories accomplish something for pure science, albeit with little direct encouragement and in spite of difficulties. The official chemist, unlike his commercial brother, is not always crowded for time; his work can be done in a somewhat more leisurely manner, for it is unaffected by any demand for immediate financial returns; and so abstract researches, if they bear in any way upon the problems which are assigned him, are sometimes within his reach. Chemistry owes much to investigations of this class; and the papers which issue from official laboratories are by no means to be despised. Good work is done, but there ought to be more of it; research should become a recognized duty, rather than an employment for spare time. It would be well if every government could be made to see that the use of science implies the encouragement of science; for then we might hope for the establishment of laboratories for purposes of investigation alone. To this proposition I shall recur later.

We now come to the fourth of the agencies by which chemistry has been developed, the educational, and this is the most important of all. Scientific research has become a definite function of the modern university, wherein the creation of knowledge is given equal rank with the distribution thereof. Education to-day differs from the education of former times, in that a lower place is given to mere authority; it goes more to the foundation of things, and so secures a foothold from which it can build much higher. Research, both for its own sake and as an example to the student, is now expected of the teacher; his pupils, coming face to face with the limitations of knowledge, are shown the problems which demand solution, and are taught something, by practice and by precept, of the manner in which they can be solved. The student learns that science is a living growth, and that every earnest, sincere, well-trained scholar can do something towards its development. If we examine the chemical journals of the nineteenth century, we shall find that by far the larger part of the discoveries therein recorded were made in the laboratories of universities or schools. Even in our own journal, with all its contributions from technical and official sources, over sixty per cent. of the communications published are of this class. The significance of this fact, however, must not be overestimated; we should remember the restrictions under which the technical chemist labors, whereas to the university professor publication is almost as the breath of life. His professional standing, his chances of promotion, are profoundly affected by the amount and character of the work which he puts forth; silence, to him, means the possible reproach of inactivity; he must publish or remain obscure. Furthermore, we must not forget that the teacher owes a debt to technology which can never be repaid. The commercial demand for applications of science has enlarged the field of education, by compelling the establishment of polytechnic schools. These institutions, all of them of recent date, give employment to thousands of instructors; they supplement the universities, they multiply the facilities for scientific work, and from them, too, there flows a steady stream of contributions to knowledge, to which the chemist is adding his full share.

Apart from the freedom to publish, the university teacher has one great advantage over the technical man. He is not confined to any limited field of operations, such as the chemistry of soap, or iron, or coal-tar; the whole domain of the science lies open before him to explore where he will. The possible utility of the work need not occupy his mind; he can attack any problem he chooses, and from any point of view. And yet, with all incentives to breadth, his researches may still be tainted with narrowness, for the inevitable tendency to specialize puts its restrictions upon him. It is much easier to be a physical chemist, an organic chemist, an agricultural chemist or an analyst, than it is to be a chemist; and chemists, in the larger sense, are few. It was Berzelius, I think, who said that he was the last man who could ever know all chemistry, and the saying was both wise and true. Sixty years ago our science could be mastered in its entirety by one industrious student; to-day it is so vast that subdivision is necessary. Still, special research is not incompatible with breadth of view; every chemist should understand the nature of the great central problems; he should stand high enough to overlook the field, no matter how small a corner of it he may prefer to cultivate personally. Broadness of mind does not imply a scattering of resources, a futile waste of opportunity; it means an intelligent appreciation of all good scientific work, whether it be within our own bailiwick or elsewhere. To exalt one specialty at the expense of others, to claim supremacy for our own small interests, indicates a self-conceit which is both mischievous and absurd.

With so many opportunities for research, and with numberless problems in sight, chemistry should have grown according to some law of symmetry, giving us to-day a well-balanced and harmonious whole. History, however, tells a different tale. The science has expanded enormously in some directions, and advanced slowly in others; a glaring disproportion is the result. For this condition of affairs there are two reasons: lack of coordinated labor and the influence of fashion; for there are fashions in thinking, just as there are in dress, and only the most original minds can escape from their domination. Theoretically, every investigator is free to follow his own bent; practically, his course is shaped by a complexity of circumstances. The line of least resistance is the easiest line to take, and in science that is determined by temporary conditions. Certain researches have been fruitful; and so, like miners flocking to a new camp, we are tempted to enter the same field, rather than to play the pioneer elsewhere. The greatest prospect of immediate success is the power which attracts us. Through influences of this kind chemistry has developed unevenly, with one side over-cultivated and another suffering from neglect.

To illustrate my meaning. I do not wish to underrate the importance of organic chemistry, nor to question, in the smallest degree, the value of its achievements. Its interest, its attractiveness, the beauty of its methods, its profound influence upon chemical theory, are all admitted; and yet it has received, it seems to me, an undue share of attention. During fifty years a large majority of all chemical investigators devoted themselves to this one branch of chemistry, leaving only a few workers to occupy other fields. Organic chemistry was the fashion; in it reputations were easiest made; the great professional prizes, the best positions, went to its devotees.

Now, in spite of all that organic chemistry has accomplished, we may fairly admit that chemical research should have a broader scope. Carbon is but one element among many; and all must be considered before we can be sure that our interpretations of chemical phenomena are sound. Special cases are easily mistaken for general laws; and to such errors we become liable when we confine our studies within too narrow bounds. Fortunately for chemistry, a broadening process has begun; and the prospects for the future are most encouraging.

During the past ten or fifteen years two movements have gained headway in the chemical world. One is marked by the revival of interest in inorganic problems, the other by the development of physico-chemical research. To a certain extent the two have much in common; each one is aided, I might say fertilized, by conceptions borrowed from the organic field; both are already fruitful to a remarkable degree. Independent journals devoted entirely to inorganic or physical chemistry, have come into existence, and investigators of the highest rank fill them with contributions. It is not my purpose to discuss either movement in detail; I mention them as symptoms of a more liberal spirit in research, as indicating the commencement of a new era. Physical chemistry in particular is becoming the center of interest; laboratories are built and equipped for its benefit alone; it bids fair to surpass even organic chemistry in its dominion over chemical thought. One danger, however, confronts it—the danger of self-exaggeration, stimulated by over-popularity. Physical chemistry, to achieve the best results, has need of data drawn from other lines of chemical research; if they are neglected, it in turn will suffer. Even now too large a proportion of its votaries are working in one field; that is, on questions growing out of the current theory of solutions, and other subjects fail to receive the attention which they deserve. This state of affairs, this lack of proportion, is doubtless only temporary, for towards physical chemistry all chemical theories converge, and no phase of it, therefore, can long escape consideration. The very nature of physical chemistry implies the prohibition of narrowness; broad conceptions and deep insight are essential to its being.

When we consider the complex influences, the varied demands, through which chemistry has developed hitherto, we can only wonder at the outcome. Under the circumstances, a symmetrical growth was impossible; the marvel is that so much could have been accomplished. Out of unorganized, uncoordinated, individual efforts a true science has come into existence, equal in dignity to any other within the domain of learning. All science is defective, but in its very imperfections we find its greatest charm. Through them alone effort becomes possible; a wise discontent on our part is the first condition for progress. If all were known, research would come to an end; nothing could arouse our curiosity; the human mind would atrophy for want of exercise. The search for truth is better than the truth itself—if I may be allowed thus to paraphrase the well-known words of Lessing. In what direction, then, shall we pursue our search, and with what promise for the future? What are the needs of chemistry?

Pardon me, now, if I apparently indulge in commonplace; if I cite some considerations of almost alphabetic simplicity. Fundamental principles lie so close to our eyes that they are easily overlooked; and from negligence of that kind, misdirected effort may follow. We must review our lessons sometimes in order to make sure of what we really know. In the first place it is well to bear in mind that chemistry and physics are not sharply distinct; that they are two parts of the same great body of truth; and that neither can be studied to the best advantage without aid from the other. Both rest upon the same two basic doctrines—the conservation of energy and the persistence of matter—conceptions which supplement each other and which give our work its philosophical validity.

If we try to consider chemistry by itself, to conceive of it as an independent branch of learning, we shall find that it has but one fundamental problem, namely, the study of chemical reactions. From certain kinds of matter certain other kinds are produced; and we merely investigate the laws which govern the transformations. If we prepare new compounds, we discover that such and such reactions are possible, and we describe their products. If we are interested in chemical equilibrium, we seek to determine the limits between which a given change can occur. Even our notions of chemical structure and atomic linking are but devices through which reactions and their products may be coördinated. In every case the reaction is the ultimate object of purely chemical research, and we try to ascertain its laws. Beyond this we enter the realm of physics; we describe each kind of matter in thermal, optical, electrical, mechanical and gravitational terms, and we discuss the phenomena of chemical change in similar phraseology.

Let us take, for example, any reaction whatever, and see what its *complete* investigation signifies. At once the problem will resolve itself into four parts, two statical and two dynamical, not one of which can logically be neglected. First, there are the substances which enter into the reaction; secondly, the physical stimulus, thermal, electrical or actinic, which starts the reaction; thirdly, the phenomena which occur during the reaction; and finally, the substances produced by the reaction. An initial state of equilibrium is disturbed by some application of energy; transformations of energy take place, and in a final state of equilibrium the process comes to an end. Through a mixture of gases having certain physical properties we pass an electric spark; they unite to form a liquid with different physical properties, the process being attended by a change of volume and great evolution of heat. The fact of union is chemical; the other phenomena are physical; and the two sets of considerations are so interlaced that we are compelled to take them together. Intellectually we can discriminate between them, but the line of demarcation is essentially ideal. The chemical composition of matter cannot be studied apart from its physical relations, nor discussed without the aid of physical terminology.

It is easier to preach than to practice; to say what should be done than to do it. Between the theoretical statement of a problem and the practical method by which it may be solved there is a profound gulf, over which a direct passage is perhaps impossible. No reaction has yet been exhaustively studied on the lines which I have laid down, and possibly none ever will be, for the difficulties in the way of such a research are almost insuperable. Of all the snares which nature sets before our unwary feet, that of apparent simplicity is the most deceptive. Honest complexity, evident at sight, we may hope to overcome; it is the unseen obstacle which baffles us. In the present instance a prime difficulty is the definition, the isolation of a reaction by itself, apart from other chemical changes. Nearly every reaction which we can observe is, in reality, a complex of several reactions—a series of steps, some of which may easily escape our notice. We measure certain phenomena, only to find at last that our result is an algebraic sum, and that we have more unknown quantities than equations. We cannot solve our problem until these factors have been recognized and separated.

To study individual reactions, then, except for the determination of definite, special phases, is not the best mode of procedure; chemistry would advance but slowly were we restricted to such a method. In ordinary chemical research, in the work of the compound-maker, for example, the initial and final stages of a series of reactions are investigated, and in that way valuable data are obtained. But the aim of science is not so much to amass facts as to connect them by laws and principles; and the more general the latter become, the greater is their intellectual value. We can not build, of course, until we have the materials, but between brick-making and architecture the difference is great indeed.

Leaving now the apparently simple, and turning to the visibly complex, let us see whether we cannot attack all reactions collectively, and in that way reach a more general statement of our real experimental problems. All reactions display the same fundamental phenomena, namely, changes of composition, changes of properties and transformations of energy; if we can classify our data under these categories, we shall begin to see more clearly the road we are to follow.

Now, recurring for a moment to the analysis of a single reaction, we may consider its two statical terms, the nature of the substances with which we begin and end. In any particular instance these questions are special and limited; but through them we discover facts which may be grouped with others of like kind. Presently we shall reach the discrimination between elements and compounds; and sooner or later we shall find ourselves face to face with one of the ultimate problems of all science—the nature of matter itself. In this problem all questions of chemical composition come to a focus; it goes back of the reaction to the substances which react; but it belongs equally to physics, and its essential details admit of description only in physical terms. Chemistry, however, is doing the most towards its solution, for it is through chemical researches that variations in the composition of matter are best explained. The indebtedness of chemistry to physics is thus fully repaid.

What is matter? Is it continuous or discrete, atomic or made up of vortex rings in the ether? These questions admit of only partial answers, and doubtless their final solution is unattainable by man. They are, nevertheless, perfectly legitimate questions for science to ask; and a tentative reply, of great practical value, is given by the atomic theory. Whether it be true or false, whether the chemical atoms are ultimate or divisible, this doctrine is the connecting thread upon which our profoundest generalizations are strung, and it is hard to see how we could do without it. Once a mere speculation of philosophy, Dalton gave it quantitative meaning; and from his day to the present every great advance in chemical theory has found its clearest statement in atomic terms. Chemical equations and formulæ; the laws which correlate the density of a gas with its composition; the law of Dulong and Petit; our ideas of valency and molecular structure; the periodic law; and the relations of stereochemistry, are all connected by the atomic theory, whose retention in science is therefore fully justified. It may not be beyond criticism; indeed, it should be criticized; but it would be the utmost folly to abandon the theory before something better has been framed to take its place. Vague and unsatisfactory are the attempts which have so far been made to supplant it. Physics, unaided by chemistry, may reach the conception of molecules; but the subdivision of the latter, the identification of their parts, is the function of the chemist alone.

If the nature of matter is the first element in the study of chemical reactions, the nature of chemical union is the second. If combination consists in a juxtaposition of atoms, what is the force which draws and holds them together? Whether we can answer this question or not, we may investigate the laws under which chemical action is operative, and so develop an important portion of physical chemistry. Problems of chemical equilibrium, of limiting conditions, of affinity and the speed of reactions, all come under this heading, and these are fit subjects for investigation in the laboratory. For instance, chemical action is impossible at very low temperatures, and at sufficiently high temperatures all compounds dissociate; each reaction, therefore, is confined to a certain part of the thermometric scale, which in many cases is measurable. In other words, chemical change is a function of temperature, no matter what additional factors its complete study may involve. It may also be effected through the agency of electrical or actinic impulses; and here again experimental research has a wide field. Were physical chemistry restricted, as it is not, to this class of investigations alone, it would still have abundant occupation. These illustrations are enough for my immediate purpose, but they could be multiplied indefinitely.

Directly growing out of these two fundamental questions, and partly identifiable with them, are two other problems of great generality and importance. First, what laws connect the properties of compounds with their composition? Secondly, what laws govern the transformations of energy during chemical change? Along each of these lines a large amount of work has been done, mostly empirical; and some regularities, some minor laws, are already recognized. Systematically, however, neither field is well known, and both offer rich prizes to the investigator. Great masses of more or less available data now exist; but rarely do we find any group adequately developed. The determination of constants or the measurement of thermochemical relations is tedious in the extreme; but a vast amount of such work needs to be done under some definite system or plan. At present we have a datum here and a datum there; some one in Germany makes a few measurements, some one in France, or England, or America makes a few more; but seldom is there any attempt at cooperation, and the isolated facts do not always fit together. The thermochemical data are especially difficult to determine accurately, and still more difficult to discuss in such a way as to develop any clearly defined law. Indeed, thermochemistry, of late years, has fallen out of favor; for to many chemists, despite its promise, it seems to lead nowhere. But laws must exist under all these troubling questions, and we cannot despair of their discovery. We can accomplish little, however, unless we consider each of the four great fundamental problems with reference to the others, for they are separable only in theory. Scientific research is not linear, step following step in regular succession; it is a network, rather, whose interlacing threads are woven into patterns of infinite variety. We trace individual fibers, we see, more or less clearly, a part of the design; and this is the most that any one of us can ever hope to do.

Now, whether we regard the fundamental questions of chemistry as four in number, or condense them into two, we can use our classification as an aid to research. Success in the latter means a wise selection of problems, a choice which is conditioned by our strength and our resources; but the first step is to understand the bearings of what we are trying to do. Whether our purposes are modest or ambitious, our work must have an influence upon that of others, and the broader the plan upon which it is conceived, the better the outcome will be. One bullet well aimed is worth more than a volley at random. One fact with a purpose outweighs a hundred scattering observations. We may well ask, therefore, what investigations are most needed by chemistry to-day?

First, as to the nature of matter, with all that that question implies. Taking all kinds of matter into consideration, and starting with the established distinction between elements and compounds, it would seem to be obvious that work is most imperatively needed where our information is least complete. Some elements, some classes of compounds, have been much more exhaustively studied than others; they, therefore, can best bear a temporary neglect, our attention, in the meanwhile, being concentrated elsewhere. I do not mean by this that any kind of research should cease, only that each department should assume something like reasonable proportions. To organic chemistry, for example, we are indebted for many methods of research, and for theoretical conceptions of great fertility; but it is now time to apply them to inorganic substances, and to see whether they are generally valid. Whatever result is reached, organic chemistry itself will be the gainer; enriched by new suggestions and resting upon firmer foundations, its future advancement can be made all the more certain. Meanwhile, carbon compounds, by virtue of their serial relations, are of peculiar value in certain lines of physico-chemical investigations; and they may also be profitably studied along the vague boundary which separates organic from inorganic chemistry. What we may call the contact phenomena between any two departments of knowledge are always interesting.

In the present revival of inorganic chemistry, a limited number of subjects have received the most attention. Among them I may name the study of double salts, of the rare earths and of complex acids and bases. All this work is of value; some of it is fundamental; but more urgent, probably, is a revision of the older data concerning much simpler bodies. This task is not attractive; it is far from brilliant in character and promises no startling discoveries; but it is none the less essential if we wish to establish the foundations of chemistry more securely. Consider any group of inorganic compounds, as, for example, the anhydrous metallic halides, and we soon find that our knowledge of them is full of gaps, and that the descriptions of many presumably well-known substances are wretchedly incomplete and defective. To remedy this condition of affairs is no small matter; there are errors to eliminate and careless work to be done over; but with modern resources a great improvement is possible. Now, thanks to physical chemistry, we can determine molecular weights, either by cryoscopic or ebullioscopic methods; and in the periodic law we have a basis for scientific classification. With these aids to research the new data should assume a theoretical value which formerly was lacking. For instance, the structural side of inorganic chemistry has been wofully defective; but now, knowing the molecular weights of substances, problems of structure may be attacked to advantage. The conception of valency can thus be tested to the uttermost degree.

Underlying all work upon compounds, however, is the study of the elements themselves. We may speculate as to their ultimate nature, or we may condemn speculation as useless; but we must agree that accurate knowledge of their relations and properties is most desirable, and especially so with respect to physico-chemical researches. In order to correlate the properties of compounds with those of their components, we must first determine the latter, and our present knowledge in this direction is exceedingly incomplete. Not one element is thoroughly known on the physical side, and some, indeed, have not as yet been definitely isolated. What we require is the exact measurement of all the physical properties of all the chemical elements at all available temperatures; from such data laws are sure to follow. Here again the periodic law can guide us; for in its curves the measured constants are easiest compared. In this scheme, evidently, the accurate determination of atomic weights is an important feature, for with them all else is coordinated. We also need to know, more completely than we do at present, the molecular weights of the free elements, because the reactions which we really observe are between molecules and not between atoms. Thus, when monatomic mercury unites with octatomic sulphur, the phenomena which occur involve the breaking down of the sulphur molecule. If, instead of mercury, we have diatomic oxygen or tetratomic arsenic, the reaction with sulphur becomes still more complex, for in each case, before combination, two molecules must be dissociated. The dissociation, of course, implies a loss of energy, of unknown amount; and in thermochemical discussions this undetermined factor is the chief obstacle to progress. If we could study reactions between monatomic molecules alone, we should have ideally the simplest conditions for thermochemical measurement. But such reactions might be difficult to identify, if indeed, they are possible at all. These considerations are obvious enough, but, unfortunately, they are sometimes overlooked.

Of the second great problem of chemistry, the nature of chemical combination, I need say little more. Some of the subordinate questions which grow out of it have been already mentioned, and each of them is a center of activity in the chemical research of the day. The entire field, however, is not covered, and here and there we can see evidences of neglect. First, we need to know under what conditions chemical change is possible. Then, if we would truly understand what chemical attraction means, we must study much more fully than hitherto its relations to other forces. How do heat, or light, or electricity inaugurate a reaction, and how are they produced by it? Questions of equilibrium are important, but they are subordinate to these. Furthermore, is chemical union of one kind only, or do we confuse different phenomena under the single name? Some authors write of atomic and molecular combinations as if they were distinct; are they really so, or is the separation nothing more than a confession of ignorance? For example, what is water of crystallization? Here is one of the commonest phenomena of chemistry entirely unexplained.

Up to this point I have considered the needs of chemistry from the theoretical side alone, as if we had only a matter of pure science to deal with. But the question has other aspects, of equal importance to us, and these now claim our attention. In order to enlarge the possibilities of research, what more do we need in the way of opportunities and resources?

To the sporadic, the piecemeal, the almost accidental character of scientific investigation I have already referred. Rarely do we find a man who can take up a large problem in a large way, with all its ramifications and details; even the most favored investigator must confine his personal work within narrow bounds, and do the best he can in his own corner. The greater part of chemical discovery has been the result of individual effort—the work of men who labored independently of one another, with rare cooperation, and often under conditions of the least favorable kind. By an army of volunteers, undisciplined and unofficered, the victories of science have been won. The time is now ripe for something better—how to organize research is the problem to be solved.

I do not mean to imply, by this suggestion, that any existing agency for research should be destroyed, or even supplanted; for such a proposition would be foolish in the extreme. Individual initiative, personal enthusiasm, are too precious to be lost; they have their part to play in the development of science; and the smallest fact, discovered by the humblest worker, will always be welcome. I do believe, however, that present conditions may be improved; that the efficiency of the individual can be increased; and to this end I urge upon your consideration the possibility of cooperation between those investigators who happen to be laboring in the same field. Ten men, pulling together, can do more than twenty who are apart. Duplication of effort, the useless repetition of work, can at least be avoided.

On several former occasions I have advocated, as the most urgent need of science, the regular endowment of research. By this I do not mean the payment of salaries to men working at random, who shall each choose his own small problem and attack it in his own way. Such a procedure would increase facilities, no doubt, but it might prove to be wasteful in the end. I look rather to the establishment of institutions, wherein bodies of trained men should take up, systematically and thoroughly, the problems which are too large for individuals to handle. Suppose that some of the wealth which chemistry has created should return to it in the form of a well-built, well-equipped, and well-endowed laboratory, devoted to research alone—what might we not expect from such a foundation! Libraries, museums, schools and universities receive endowments by the score; observatories are equipped for astronomical research; why should not chemistry come in for her share of the benefactions? Are our achievements so great that we seem to need no aid? In this hint there is a modicum of truth; the users of chemistry, the great industrial leaders, see the wonderful resources of our science, and do not realize that she can require more. That the giver of help should herself demand assistance is a hard thing to explain.

This, then, is our greatest need; the endowment of laboratories for systematic research, wherein chemistry and physics shall find joint provision. I say 'systematic research,' in order to distinguish it from the uncorrelated work of separate individuals. In physics, or for physics primarily, a beginning has already been made; the Reichsanstalt, at Berlin, the new physical laboratory in London, and the Bureau of Standards, at Washington, can cover a part of the ground. But it is only a part; for in each case, and in other like institutions, the researches are undertaken mainly in response to industrial demands; to furnish methods and standards rather than to develop principles and laws. The advancement of science as science is quite another affair. Neither does the Davy-Faraday Laboratory in London exactly meet our requirements. It is organized to help individuals, by giving facilities for work; but it does not provide for the systematic investigation of large problems, through the combined efforts of a body of chemists operating under a common plan. These institutions are all steps in the evolution of the research laboratory; but the development, as yet, is incomplete. Laboratories for instruction have been lavishly provided, but in them research is subordinate to teaching. The thesis of the student may represent good work; the leisure of the instructor may be fruitful also; but organized research is a different thing, and must have its own independent resources.

Either at public expense or by private enterprise, laboratories for research should be established in all of the larger civilized countries. By conference between them their work could be so adjusted as to avoid repetition, each one reinforcing the others. Their primary function should be to perform the drudgery of science; to undertake the tedious, laborious, elaborate investigations from which the solitary worker shrinks, but which are nevertheless essential to the healthy development of chemistry. Brilliant discoveries might be made in them, but incidentally, and not as their main purpose. Such discoveries would surely follow if the fundamental work was well done; but the latter should come first as being the most essential. Whether we serve pure science or applied science, we all feel the need of data which are as yet undetermined, and whose ascertainment we cannot undertake ourselves. How often are we baffled in our own researches for want of just such material! In the verification of methods and the determination of constants, the research laboratory would have plenty to do, even were nothing more attempted.

By the creation of laboratories such as I have suggested, the independent scholar might be aided in many ways. The antecedent data, without which his researches are crippled, could often be furnished, thus opening pathways where obstacles now exist. Furthermore, the desirable cooperation between investigators would become a much simpler matter to arrange than it is now. Every laboratory for research would become a nucleus around which individual enterprises might cluster, each giving and receiving help. A great work, wisely planned, always attracts colaborers; its mere suggestiveness is enough to provoke widespread intellectual activity. Here there is no monopoly, no limit to competition, no harmful rivalry; every research is the seed of other researches, and every advance made by one scholar implies the advance of all. In the realm of thought we gain by giving; and the more lavish our offerings, the richer we become.

We glory in the achievements of chemistry, and we find merit also in its imperfections, for they give us something more to do. Never can the work be finished, never can all its possibilities be known. Hitherto the science has grown slowly and irregularly, testing its strength from step to step, and securing a sure foothold in the world. Now comes the time for better things; for system, for organization, for transforming the art of investigation itself into something like a science. The endowment of research is near at hand, and the results of it will exceed our most sanguine anticipations.

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U. S. GEOLOGICAL SURVEY.

GRADED CONDENSATION IN BENZINE VAPOR, AS EVIDENCED BY THE DISTORTED CORONAS AND MARKED AXIAL COLOR EFFECTS ATTENDING CLOUDY CONDENSATION.

1. It would be difficult to read the admirable work on the relation of rain and atmospheric electricity which has issued from the Cavendish Laboratory, without being convinced of the strength of the arguments put forth. That in a repetition of these researches, in particular of the experiments of C. T. R. Wilson* on the comparative efficiency as condensation nuclei of positively and negatively charged ions, one would but reproduce his results admits of no doubt.

In so important a question, however, it is none the less desirable to reach identical conclusions from entirely different methods of approach. It has been part of my purpose to be driven to like inferences; in other words, to reach a point in my work where I should have to abandon the nucleus as an agency which for purely mechanical or thermodynamic reasons facilitates condensation, and be compelled to recognize the special activity due to its charge.

I had hoped to accomplish this in the following experiments with benzine when contrasted with the corresponding behavior of water; but the results, contrary to my expectation, are so curious and pronounced an accentuation of the nuclear theory that it seems worth while to specially describe them.

2. The work originated in the following point of view: if the action promoting condensation is in any degree of a chemical nature (such suppositions have been made; the production of hydrogen superoxide, for instance, has been suggested), then there should be a marked difference in the efficacy of the same nucleus when the saturated water vapor is replaced by the vapor of some electrolytically neutral liquid, like a hydrocarbon. I accordingly made a series of experiments with benzine, endeavoring at first to utilize benzine jet and color tube in the usual way. In this I failed for reasons without much relevant interest here. I then adopted the method of adiabatic cooling, partially exhausting a spherical receiver (Coulier, Kiessling) about 23 cm. in diameter, illuminated by

*C. T. R. Wilson, *Phil. Trans.*, London, Vol. CXCIII., pp. 289–308, 1899.

white light diverging from an external point. In this way not only were copious fogs obtained, but the coronas* produced were additionally available as evidence.

In the benzine jet, particles are probably cooled too suddenly, and at once attain a size incompatible with axial color effects. Using the exhaustion method, however, these axial colors appearing in benzine are not only of pronounced depth, but they run into higher orders than in the case of moist air subjected to like exhaustions. Sequences passing through blue, green, yellow, brown, purple, etc., green, brown, etc., may be seen in the axis of a column only 23 cm. long. The reason, no doubt, is the lower latent heat of benzine, insuring the formation of drops not less uniform, but of a size, cæt. par., regularly larger than for water vapor. The fact that axial colors are producible both with water and with a pronounced insulator like benzine, is a result of fundamental importance in its bearing on any theory adduced to account for the axial absorption in question.

3. The exhaustion experiments were thus at once successful. Cloudy condensation was as densely produced in benzine vapor as in water vapor, with phosphorus, flame and other nuclei. Care was taken to insure dryness of vessel by test experiments both before the benzine was introduced and after it had been quite removed by evaporation. The exhaustion of about one sixth, say 13 cm., seemed best adapted to bring out the following phenomena. When the receiver was left standing overnight no marked condensation occurred in the absence of nucleation, or else the condensation was rain, like a fine mist, falling about 2 or 3 cm. per second.

The introductory experiments were made with light nearly in parallel, the sun's image being used as a coronal center. The even dense tawny benzine fog after the first nucleation was expected to develop on subsequent exhaustions (each followed by an influx of filtered air) into the magnificent coronas which characterize this experiment in the case of water vapor. On the contrary, however, the fogs were more fleeting, showed a more rapid descent than aqueous fogs, and the color fields obtained were not ring-shaped as expected, but *sharply stratified, horizontally,* roughly speaking, in alternations of green and red.

Moreover, if the exhaustions were made successive without influx of air between each, the colors rose in strata from below, as they fell in strata when left to themselves. On mounting, the strata grew successively wider and thinner till they vanished from sight, brown, yellow-white being the last colors observed. Uniform color fields (strata of limiting width) were eventually producible in this way. Yellow, brown, crimson, arose from a whitish blue base, then descended again on completed exhaustion, reminding one of the extension of an accordion. The speed of apparent viscous subsidence of the top bands has no direct meaning, since fall (or rise) is here complicated by evaporation.

On entrance of air, vortices were evidenced by ring-shaped threads of color so that mixture was at first inevitable. One must wait till this ceases before again exhausting. Convection currents due to local reheating of the adiabatically cooled gas by the walls of the receiver, were equally apparent, stringy colors rising on the out-

*For some time I have been making experiments with the coronas of cloudy condensation on a large scale, with the purpose of comparing the diffraction colors so produced with the axial colors of the steam jet. The latter are almost complementary to the colors of the central patches of the corresponding coronas, betraying a difference of origin in the two cases of great theoretical interest. One is tempted to infer that the light axially absorbed illuminates the colored inner circle of the corona, but the proof of such an assertion is a long stride.

side and descending into the middle of the receiver. It is the phenomenon which interferes with the usefulness of narrow tubular apparatus.

4. As this subsidence of color bands in benzine vapor is an observation of importance, I resolved to repeat the work under more normal conditions. Accordingly I used as my source of light the bright area of the mantle of a Welsbach burner, seen through a small hole in the metallic screen by an eye, looking centrally through the receiver containing saturated benzine vapor and nucleated air. Punk nuclei replaced the phosphorus nuclei. On exhaustion (without nucleation) after standing overnight, the coronas were white centered fringed with brown, about as large as ordinary lycopodium coronas seen under like conditions. These large drops are a proof of the relative absence of nuclei initially.

After nucleation the first dense fogs were vaguely annular during the first five successive exhaustions, filtered air being supplied between each. The next five exhaustions produced more nearly, finally very fully stratified colors, in spite of the point source of light. Shaking the receiver violently at any time, so as to scatter the liquid benzine within, always reproduced a nearly perfect corona, which on standing became distorted again, in color at least. I now made special experiments, shaking the receiver before each observation, bringing out successive coronal effects* never as perfect as with water, however, always showing the tendency to stratification. The characteristic coronas succeeded each other so rapidly that it would be difficult to make them out. Nuclei, however, were still present after over two hours, the eventually white centered coronas showing a continued shrinkage to smaller diameters in accordance with the diminishing number of nuclei present. Twenty exhaustions did not remove them.

* These will be described for water vapor in a subsequent paper.

Here, as above, therefore, the fleeting character of the coronas, their tendency to depart from the normal annular character into stratification, the speed of descent of the color bands, their rise upward on exhaustion like a fog from a lake, are the special characteristics of the colored cloudy condensation occurring in benzine. To these are to be added the striking axial colors mentioned above.

5. To explain the above phenomena in their variation from the normal aqueous corona, it is first necessary to account for the more rapid subsidence of nuclei. I am not aware of appreciable differences of viscosity in the two vapors; but benzine has the smaller latent heat of evaporation by over seven times. Hence under identical conditions of nucleation and for like exhaustions or like adiabatic cooling of a given mass of saturated air, the drops would be larger, the colors more advanced in benzine than in water; and since the square of radius is in question, this would point to subsidence of the loaded nuclei in benzine nearly four times more rapid. It would also account for more rapid evaporation or more fleeting colors, which is the case.

Again, if the loaded nuclei be regarded as mechanical particles, the largest will eventually be found in the lower strata, the smallest in the upper strata, as in a case of ordinary subsidence of suspended matter in water. It is well known, moreover, that smaller droplets wane, larger droplets grow. Hence on increasing exhaustion condensation takes place first at the bottom and last at the top, since the smallest nuclei correspond to greatest vapor pressure or difficulty in condensation, and since the largest nuclei have been loaded with condensed liquid first, have parted with it last, have had greater time in falling and have therefore sunk deepest before losing their liquid load. The strata mount upward as fresh exhaustion proceeds. The last colors to appear are the browns and yellows of the first order, also seen in the steam tube for vanishing condensations. The whole phenomenon is thus the result of strata of invisible nuclei, *graded in virtue of the loading mechanism*, and partakes throughout of a mechanical character to the extent that the nuclei are *not even a uniform product*. The forced distribution is sufficiently powerful to entirely mask the elementary optical phenomenon.*

On shaking the liquid benzine in the receiver uniform distribution is again promoted, with the result that annular coronas reappear. It is particularly to be noticed that subsidence is due to loaded nuclei. The free nucleus does not appreciably descend. Even with water vapor, loading does not produce stratification. Water fogs when exceptionally dense may sometimes be seen to rise, but the diffraction pattern is always annular and usually without color distortion.

* Since writing the above I have made similar experiments with benzol, reaching the additional result that nuclei are produced by the liquid itself, *spontaneously*, in the dark. They ascend against gravity in horizontal strata, at the rate of 2 or 3 cm. per sec. in the lower hemisphere. They may be completely precipitated by partial exhaustion, leaving the air in the vessel free from nuclei (but the above flask will be refilled to saturation in 10 or 20 minutes). The experiment may be repeated any number of times. The sharp demarcation of the pure air above from the rising surface of nuclei is beautifully evidenced by the coronas, which are annularly perfect for axial beams below the surface, asymptotically *bowl-shaped* at the surface, and absent for axial beams above the surface. Shaking produces the coronas from pure air instantly, but these are usually smaller. In so far as the spontaneous coronas have fixed diameters for fixed exhaustions (supersaturation), the number of nuclei eventually reaches a maximum or saturation. Among many interesting problems growing out of the present observations, the corresponding behavior of water is most important.

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DATA ON SONG IN BIRDS: THE ACQUISITION OF NEW SONGS.

The purpose of this paper is to set forth the evidence that has come under the writer's personal observation regarding the propensity of birds to acquire new methods of expression in song.

This faculty may be properly divided into three categories: First, the disposition of wild birds to interpolate new phrasing into what may be called their normal song, or *to acquire new songs*. Second, education of expression, by direct teaching from man to birds in confinement. Third, the propensity of caged birds to imitate, voluntarily, sounds that attract their attention.

The evidence under the first division of this thesis is absolute and also well known. However, a few special cases may serve to emphasize the matter.

Every trained field ornithologist discriminates individuality in song, and some have been so fortunate as to have noted wide and radical departures from what I have distinguished as the normal song. The slight variation from the normal is of too common occurrence to be dwelt on here. Suffice to say that as set forth in a previous paper in this journal,* most observers recognize degrees of excellence in the songs of wild birds of the same kind.

Again, a few observers have heard wild birds imitate or produce not only the songs of other birds, but also the barking of dogs, human speech and mechanically produced sounds such as the creaking of a wheel, the filing of a saw and the like. The facility

* See Science, October 4, 1901, p. 522.

of the mocking-bird in this particular is traditional. A few other instances seem worthy of record.

A catbird (*G. carolinensis*) that nested in the immediate vicinity of my house in the season of 1900 reproduced the call of the whip-poor-will (*A. vociferus*) so perfectly that it was difficult to induce members of my family and visitors who heard the reproduction to credit the fact that it was not the whip-poor-will singing. A friend who knew nothing about the catbird as an agent in the performance and who had not had her attention called to the matter in any way told me that she had heard a whip-poor-will singing near my house repeatedly in *the day time*, and wished to know if this was the ordinary habit of the bird. In a residence of some twenty years in this locality I have never heard whip-poor-wills nearer to the point in question than three miles.

The following case of a wild rose-breasted grosbeak (*Z. ludoviciana*) *talking* is well attested. I quote from Emily B. Pellet, Worcester, Mass., in *Bird-Lore*, Vol. III., No. 5, p. 174, October, 1901, as follows: "Early last summer, while standing on my back steps, I heard a cheerful voice say, 'You're a pretty bird. Where are you?' I supposed it to be the voice of a parrot, but wondered how any parrot could talk loud enough to be heard at that distance, for the houses on the street back of us are quite a way off.

"Almost before I had done laughing, the voice came again, clear, musical and strong—'You're a pretty bird. Where are you?'

"For several days I endured the suspense of waiting for time to investigate. Then I chased him up. There he was in the top of a walnut tree, his gorgeous attire telling me immediately that he was a rose-breasted grosbeak.

"At the end of a week he varied his compliment to 'Pretty, pretty bird, where are you? Where are you?' With a kind of impatient jerk on the last you.

"He and his mate stayed near us all last summer, and though I heard him talk a hundred times, yet he always brought a feeling of gladness and a laugh.

"Our friend has come back again this spring. About May 1 I heard the same endearing compliment as before.

"Several of my friends whom I have told about him have asked, 'Does he say the words plainly? Do you mean that he really talks?' My reply is, 'He says them just as plainly as a bird ever says anything, so plainly, that even now I laugh whenever I hear him.'"

Space will not allow the further elaboration of this part of the subject.

The second division, that of education of birds in song and speech by man, is also well known. The bullfinch's (*Pyrrhula europæa*) ability to learn to whistle airs with great accuracy and precision, as well as the peculiar quality and charm of its voice, has arrested the attention of all observers and has been cultivated for more than a century. Few of us, however, realize that only *wild birds* hand-reared from a very early age are educated in this accomplishment, and it is worthy of special notice that wild bullfinches have little or no song, and may be compared with the European sparrow (*P. domesticus*) as a songster. Starlings (*Sturnus vulgaris*) are well known as birds susceptible not only of learning to whistle simple melodies, but as rivals of parrots in reproducing with great distinctness short sentences. Parrots are proverbial as talkers, singers and whistlers. Canary birds have frequently been recorded as learning to whistle simple tunes, and there are a number of well-attested accounts of their reproducing with precision short sentences. Jays, crows and magpies also talk and whistle with great facility. The voices of jays in reproducing speech are particularly melodious and lack the peculiar phonographic timbre characteristic of most parrots and of starlings.

Mention must be made here of the minos (genus *Mainatus*) of India as on the whole the most receptive among birds in learning to talk, sing and imitate all sounds of a mechanical kind. All these results have been achieved by education, that is, direct teaching with intent on the part of the human instructor.

The third part of this discussion, that which deals with the propensity of caged birds to imitate or reproduce, voluntarily, sounds that attract their attention, needs a few words of explanation.

No direct effort or intention on the part of a human agent is a factor in this category. All but one instance that I shall adduce of this kind of ability have occurred in an experience covering some six or seven years with birds obtained in ways, and kept under conditions, that require brief consideration. These birds are all hand-reared wild species; birds taken from the nest when very young and raised by hand. As soon as such birds were able to feed and care for themselves they were liberated in large rooms having as near freedom as confinement would allow. No instruction was given to them. In a word, it was an effort to observe *what birds would do if left to themselves and supplied with food and water*. No effort was made to keep these birds from hearing the song of wild birds out of doors. The species dealt with in this way are comprised in the following list:

12 bluebirds (*Sialia sialis*).

14 robins (*Merula migratoria*).

6 wood thrushes (*Hylocichla mustelina*).

7 catbirds (*Galeoscoptes carolinensis*).

2 thrashers (*Harporhynchus rufus*).

2 yellow-breasted chats (*Icteria virens*).

2 rose-breasted grosbeaks (*Zamelodia ludoviciana*).

1 cardinal (*Cardinalis cardinalis*).

6 Baltimore orioles (*Icterus galbula*).

7 orchard orioles (*Icterus spurius*).

1 bobolink (*Dolichonyx oryzivorus*).

2 cowbirds (*Molothrus ater*).

4 crow-blackbirds (*Quiscalus quiscula*).

5 red-winged blackbirds (*Agelaius phœniceus*).

1 meadow-lark (*Sturnella magna*).

6 blue jays (*Cyanocitta cristata*).

It will be sufficient for us to consider only the very marked acquirement shown by individuals among these birds, none of whose songs are quite normal. A number of the robins have peculiar songs that in no way resemble wild robins' songs. I should call them *invented* songs, for lack of a better name.

The wood thrushes' song varies much from the normal, but can hardly be regarded as invented or original.

Catbirds did much mimicry of the songs of other birds.

A yellow-breasted chat is worthy of particular mention. This was a bird taken with another from a nest in May. In September of the same year I was busy in correcting proof for a forthcoming book of some size, so that for at least three months a part of each day was devoted to this work. The manuscript and proof were delivered by a postman. There were three deliveries each day. Ordinarily the postman dropped the mail into a slot in the door, but when he had a package of proof this was not feasible and he sounded a call or postman's whistle for some one to come to relieve him. One afternoon in September, about the time I was expecting proof the whistle sounded and I went to the door. No one was there. My first impression was that some boy in the neighborhood was up to mischief. The experience occurred four or five times in the next day or two and I began to regard it as mysterious, never thinking of the birds in such a connection. Some four days later while watching the birds—I was in the room with them—a chat came and alighted on my shoulder and shrill in my ear sounded the exact reproduction of the postman's call. The very direction and distance from which the call came and its exact tone were reproduced. I heard it many times afterward, friends and other members of the family became familiar with the call, and even after I was aware of it, when I was expectant, I have heard the postman, gone to the door and finding no one, knew how realistic was the reproduction of the postman's call by a yellow-breasted chat.

One of a brood of red-winged blackbirds (*A. phœniceus*), a male, crows constantly for all but two months in the year. The crow is an imitation of the crow of the common bantam rooster. Distance and direction are clearly indicated. The sound always appears to come from the rear of the house, at some little distance, and is a very clever imitation of the crow of a bantam rooster. This is the only song this bird has.

A blue jay (*C. cristata*) reproduces the song of the cardinal (*C. cardinalis*) so perfectly as to deceive any one. It is copied from a cardinal in the room, and distance and direction are not indicated.

A European jay (*Garrulus glandarius*) has learned from a cockatoo to say 'How do you do,' 'How do, pretty polly,' 'Pretty polly' and some whistles and calls.

"Last summer on a Wisconsin farm there was a duck hatched out with thirteen turkeys by a hen as a foster-mother. This duck followed the turkeys around and wavered a very long time before it went into the water, and it still imitates the *turkey's note* with its *duck voice*. It sleeps under the turkeys' roost at night now, although it is quite an old duck, and scorns the company of the other ducks on the plantation. This interesting family is on the farm of Mr. Clinton D. Stewart, whose post-office address is Dousman, Wisconsin. Mrs. Merrick first called my attention to the duck's turkey call; but I was not entirely satisfied until I heard it myself." (Extract from letter of Edwin T. Merrick, 836 Gravier street, New Orleans, La., October 19, 1901, to W. E. D. Scott.)

This call of the turkey given by a duck is of special interest as præcocial birds appear to have much less receptivity than altricial birds. The reason seems obvious.

In concluding a word is necessary as to the probable reason why birds in confinement diverge from the normal in the habits of song. Presuming that wild birds are pretty constantly employed in obtaining a food supply, it would seem that they *do not have much leisure*. On the contrary, birds in captivity with all their physical wants carefully looked after, *have leisure* and employ it in giving their attention to occurrences about them, particularly such as are accompanied by any noise.

Of this factor of leisure among animals in confinement little is known, and a broad field is presented for those investigators who have opportunities in zoological gardens or, better still, in special laboratories equipped for this and kindred studies.

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MUSEUM STUDY BY CHICAGO PUBLIC SCHOOLS.

THE Field Columbian Museum is often visited by classes from the Chicago public schools for purposes of instruction obtained by studying the illustrations there afforded of different subjects taught in the schools. The character and value of such work vary of course with the age and standing of the pupils, and doubtless as well with the individuality of the teacher.

The teachers with whom I have talked are unanimous in saying that the pupils enjoy study at the Museum, not having to be urged to it as to book study, partly, of course, because of the change it affords from the routine of school work, but largely because the objects of study are so tangible and interesting of themselves. Many of the scholars spend considerable time in voluntary study at the Museum outside of school hours. The teachers also say, however, that as might be expected, no immediate results are realized from such work unless the pupils know that some report of their studies will be called for. Such report may be made orally or as a written report on some department of study, or on topics previously assigned. I have sometimes examined such written reports and have found their perusal of considerable interest and value. They furnish as accurate a test as could be devised, probably, of the amount and kind of instruction which pupils are likely to obtain from study of objects in a museum and as well also of that likely to be obtained by those 'children of a larger growth' who visit the Museum with a less definite desire for instruction, but who imbibe it nevertheless. The particular lot of reports now lying on my desk is one of about twenty made by pupils in a class in physiography in the first year in high school, ages say 13 to 15 years. The reports or essays as they might also be called, are descriptive of a visit to the geological department of the Museum for the purpose of finding and noting illustrations of the text-book study of physiography. The pupils were expected to make drawings as well as notes of the objects which they deemed important and such drawings accompany the essays. Some suggestions had previously been given the pupils by the teacher as to topics for study, such as the description of fossils from each of the great geological periods; the study of crystals, meteorites, some special relief maps, etc.

Some points noted in the perusal of the essays may be worthy of comment. The ideas gained by the pupils from the study of the collection of fossils were isolated and fragmentary. Single forms were drawn and described with considerable accuracy, but there seemed to be little conception gained of the march and development of life as a whole, although the collection is sufficiently large and complete to make this manifest. Still, several noted the introduction of fishes in the Devonian age and the excess of vegetation in the Carboniferous. None of the pupils mentioned the animals of larger size, although many skeletons and restorations of these are exhibited. It is curious that while the average visitor of maturer age devotes his attention almost exclusively to these, I have never noticed young people take much interest in them. They take more interest in small objects, such as shells, impressions of ferns, etc. The color of the fossils or matrix was often noted and throughout the essays observation of color is the one thing prominent. The remarks on crystals contained few observations calculated to encourage the modern crystallographer. Almost anything in the mineral collection was regarded as a crystal and the observations made were chiefly on differences of color. From a collection of crystals arranged according to the six systems, one scholar drew the sweeping conclusion that 'isometric crystals are green, yellow-green or cream color; those of the tetragonal system generally red, those of the hexagonal system vermilion,' etc. This was a conclusion from scanty data, but the scoffer may be reminded that the whole world did not do much better in its study of crystals up to the beginning of the seventeenth century, as witness its reasoning that because quartz was found on the high Alps and sometimes contained water that *ergo* it must be ice frozen so hard it could not melt. A few of the pupils, however, distinguished crystal forms quite accurately and drew excellent representations of them. I believe distinctions of form might be easily taught to pupils of this age and even younger if more attention was paid to it. In nearly all lines of scientific study form is far more important than color.

In their study of meteorites nearly all noticed the 'thumb marks' and gave a reasonable explanation for them. They also noticed the composition of meteorites as made up of iron and stone in different amounts. The finer details of structure were entirely overlooked, however. Only one noticed the Widmanstättian figures, describing them as 'scratches,' and the chondritic structure was not noted at all.

The observations drawn from a study of the relief maps excelled all others in accuracy and fullness.

The region of the Grand Cañon of the Colorado, for instance, was correctly described as a valley worn to a profile of equilibrium into which a subsequent cañon had been cut by the rise of the land. This had doubtless been stated in the text-book, but the relief map evidently gave the subject a vividness and reality. So also from a map showing the extent of the continental glacier, the southern limit of the glacier was correctly traced and a permanent impression, doubtless, of an important fact gained. On other relief maps the positions and relations of plateaus, divides and slopes were correctly noted and single geologic features accurately described. One could not read over the portions of the essays devoted to this subject without being convinced that relief maps are most desirable adjuncts for the teaching of geography.

Some glaciated surfaces were noted by all, but few gave a correct explanation for the markings on them although the origin of the markings was stated in an accompanying label. One thought they were due to running water, another to 'undulations in the ground moraine.' I doubt if the young mind is able to conceive fully of the physical effects of a continental glacier.

Graphite was studied by many of the pupils, their interest in it presumably being aroused by their familiarity with it in lead-pencils. The fact that it was black was the principal point noted, although some listed the localities whence it is obtained. From some inconceivable source one lad drew the information that "graphite is used for egg coal, because it contains a great deal of oil, so that it is used where a fire is needed. Coal dust moulded by pressure forms graphite."

The accounts of petroleum and its uses were generally full and accurate and must have been drawn almost entirely from observations on the collection. Such a knowledge of petroleum could not have been gained by reading a dozen books. Asbestos, salt, gypsum, mica and sulphur were among other substances noted, some account being given of the appearance and uses of each. The statements were partly second-hand and partly original, with no evidence of any particular skill in observation. One girl, for instance, stated she could see no difference in appearance between gypsum and asbestos, though the distinction should have been plain. It was evident that the pupils had not as a whole been trained to careful observation, for many obvious distinctions were overlooked.

On the whole the essays showed the need of museum study rather than important results from it. They painfully evinced the fact that copied labels and statements of text-books furnished the material out of which they were chiefly made. Doubtless many of the labels were copied without a glance at the specimen which it accompanied. There was far too little evidence of individual, independent observation. Let it be noted, however, that the essays which contained the most personal observations were the most accurate. It was in the essays most largely made up of copied labels that such strangely conglomerated statements as those I have quoted were to be found. This inculcated slavery to print is to my mind one great weakness of modern instruction in the elementary schools, so far as any hope of the promotion of science is concerned, and it is in museum study that one of the best remedies for it is to be found. In order that independent study may be encouraged it may be questioned whether the museum label should aim to give very extended information. To be sure, the mere copying or reading of the label serves to some extent to fix the information it contains upon the mind, but the knowledge would take firmer hold if this information could be gained by a study of the specimen. I have often noticed visitors of all ages studying an unlabeled collection with the greatest persistency and interest, and then have seen them finish it in a glance after it was labeled. They seemed to feel that they were relieved of any further responsibility in regard to it as soon as they saw the labels. Hence, Goode's well-known aphorism that 'a museum should consist of a collection of instructive labels illustrated by specimens' has its limitations. Uttered to call attention to the need for system and as a protest against the lumber room, it had a profound value, but modern experience will hardly consider it a final ideal. It is possible to so prepare and arrange collections that they will tell their own story without more labels than are needed to serve as hints or indexes. Such collections or exhibits will promote the spirit of observation, study and inquiry, and the more they do this the more will they contribute to the advancement of science.

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Field Columbian Museum.

THE BOUNDARY LINE BETWEEN TEXAS AND NEW MEXICO.

The boundary line between Texas and New Mexico along the 103d meridian was the chief theme of a talk before the National Geographic Society on November 15 by Dr. Marcus Baker. This boundary, created in 1850, was surveyed and monumented, in part, in 1859 by John H. Clark, and his survey was confirmed by Congress in 1891. Recent official maps place this boundary two or three miles west of the 103d meridian, where the law declares it to be. The paper read before the Society was a summary of the results of an enquiry undertaken to discover and weigh the reasons for this discrepancy.

The original monuments set by a survey to mark a boundary in accordance with law, become, when confirmed, the boundary, even when followed by more accurate surveys which show the original monuments not to be where they were designed to be. The more accurate survey does not alter the boundary. It merely shows how well or ill the original survey was done. Of this line, 310 miles long, 180 miles were traced out and marked by mounds of earth or stone in 1859; the remaining 130 miles have not been surveyed. Of the 180 miles surveyed and marked, 24 are at the south end marked by 3 mounds and 156 at the north end marked by 23 mounds. The longitude of the south end of the line was determined by chaining eastward from El Paso along the 32d parallel 211 miles, the initial station being

Frontera of the Mexican boundary survey. Obviously this is a very weak longitude determination. It was not checked by astronomical observations originally, nor has it been since. Nor has it been checked in any other way. According to present knowledge the three monuments at the south end are on the 103d meridian and should be so shown on our maps until subsequent and better surveys shall find these monuments and show that they are not on the 103d meridian. As to the 130 miles of unsurveyed line north of the short piece, at the south end of the boundary, this part is obviously coincident with the meridian.

The longitude of the 23 mounds on the northern part of the line depends upon the one at the N.W. corner of Texas. That corner monument was set in August, 1859. Its longitude was obtained by transfer from some point on the 37th parallel, 35 miles to the northward. In 1857 a surveying party under Lieutenant-Colonel Johnston measured westward along the 37th parallel from the west boundary of Missouri 471 miles to the 103d meridian. Clark was the astronomer in Johnston's party and determined by moon culminations the longitude of the monument set by Johnston to mark the intersection of the 103d meridian and 37th parallel. The longitude of the mound at the N.W. corner of Texas, set by Clark in 1859, therefore depends upon the longitude of a point determined by himself, astronomically, two years previously on the 37th parallel. How accurate was Clark's determination? Nobody knows. Various surveys under the direction of the Land Office have been made in this vicinity since Clark's original one, but his monument has not been found. Two monuments have since been established to mark the point which Clark intended to mark and which he supposed he did mark. One of these was set by John J. Major, in 1874, and another by Richard O. Chaney, in 1881. Major searched for Clark's monument, failed to find it and 'reestablished' it, *i. e.*, set a new one. The evidence is conclusive that Major's monument was set more than two miles west of Clark's. Chaney's monument is some four or five miles east of Major's. Chaney did not find either Clark's or Major's. Thus three monuments or mounds have been built to mark the N.W. corner of Texas, one by Clark in 1859, another by Major in 1874, and a third by Chaney in 1881. Clark's alone marks the boundary and that one is lost.

Of the 22 remaining mounds marking the northern part of the boundary two, and only two, are known to still exist. These two are in sight of one another and on opposite banks of the Canadian River. They were found and reported to the General Land Office by the land surveyors Taylor and Fuss in 1883. We have no information as to their longitude other than that furnished by Clark himself, who reported them on the 103d meridian.

In the present state of our knowledge it seems highly desirable that the boundary should appear on our maps on the 103d meridian. At the same time it is even more important that topographic surveys be made along this line and as many as possible of the original Clark monuments identified and accurately placed on the map. This done the whole line should be run out, old monuments restored and new monuments built. If this is done before the discovery of oil, mineral or things coveted, a costly and bitter boundary dispute can be avoided.

Since the above was written I have learned of a recent survey which has materially added to our knowledge of the present state of this boundary. Mr. E. D. Preston, U. S. Deputy Surveyor, retraced the Clark line on the 103d meridian from the Canadian river northward to the corner, a distance of about 75 miles, in the summer of 1900. This was done by direction of the General Land Office and his MS. report is now on file in that office. Of the 12 monuments set by Clark in 1859 on this part of the line Preston identified 3 certainly and, doubtfully, 4 in all. Clark's line, according to Preston, bears N. 0° 08′ W.

In 1882 W. S. Mabry, county surveyor of Dallam county, the northwesternmost county of Texas, retraced a part of the Clark line and assisted in building a pasture fence for the XIT or Capital Land and Cattle Company. The corner of that pasture was established at the point supposed by Mabry to be Clark's corner. This XIT corner is now locally recognized as the N. W. corner of Texas. According to Preston's survey it is 'within 150 links of the proper position east of the Johnston monument.' It is about 2¼ miles east of the lost Major monument of 1874 and is 2 miles 14.05 chains west of the Chaney monument of 1881. Clark's monument, according to Clark, is in longitude 103°. Chaney's monument, according to Chaney, is in longitude 103°. These monuments differ in longitude by more than 2 miles. Which one is the better determination is unknown. Both longitudes are weak—Clark's is a fair determination by a weak method, Chaney's a weak determination by a strong method. A new and strong determination by a strong method is much to be desired.

SCIENTIFIC BOOKS.

Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera. By FREDERICK DUCANE GODMAN, D.C.L., F.R.S., and OSBERT SALVIN, M.A., F.R.S., etc. Vol. I., Text, pp. i–xlvi + 1–487; Vol. II., Text, pp. 1–782; Vol. III., Plates, I.–CXII. and XXIVa. Published by the authors. Royal 4to. 1879–1901.

In the present age it is recognized as one of the functions and duties of wealth to minister at the altar of learning. The upbuilding of great institutions, the object of which is the ascertainment of truth and the diffusion of knowledge, is regarded as one of the high prerogatives of those who have command of material resources. Splendid have been the achievements in recent years of those who have consecrated their wealth to founding or aiding in the endowment of colleges, universities, libraries and museums; but perhaps no enterprise undertaken by wealth is likely in coming years to be regarded as more important and monumental in its character than the great work to which Messrs. Frederick Ducane Godman and Osbert Salvin addressed themselves when they conceived the idea of preparing and giving to the world the encyclopedic work known as the Biologia Centrali-Americana. Of this work it may be said that it constitutes *monumentum aere perennius.*

It is with profound satisfaction that we welcome the appearance in final form of the three volumes devoted to the Rhopalocera of Mexico and the Central American republics. For twenty-two years these volumes have been slowly appearing in parts. The delay is most reasonably explained by the surviving editor and author, Mr. Godman, as due 'to the constant pressure of other work, the ever-increasing amount of material, the gradually failing health and subsequent death of Mr. Salvin, and the great difficulty of dealing with the Hesperiidæ.' The work, however, has not lost, but has rather profited by delay. The exceedingly satisfactory treatment of the Hesperiidæ, which a few years ago would have been impossible, and the supplementary pages and plates cause the student, now that the work is completed, to feel thankful that the editors followed the good maxim, *festina lente.* Had they completed the work before the region had been traversed by the various collectors whom their munificence placed in the field, and had they not been able to profit by the researches in the family of the Hesperiidæ made by Captain E. Y. Watson, the work would not have been the eminently satisfactory work which it now proves to be. There is yet much to be learned in reference to the lepidopterous fauna of Central America, and the last word has not been spoken even by the learned authors in the three stately volumes before us, but a foundation has been laid so broad and solid and enduring that all who come hereafter will be compelled to build upon it. These three volumes in a peculiar sense reflect the intelligence as well as the generosity of the two lifelong collaborators, Messrs. Godman and Salvin. With the exception of the volume upon the avifauna of the region, written by the same two gentlemen, they most strongly illustrate their learning. Other volumes in the great work reflect the excellence of their editorial supervision, as well as their munificence, but the parts of the 'Biologia' which have issued from their own hands and most strikingly display their scientific accuracy and the vastness of their learning are the volumes dealing with the birds and these three volumes treating of the butterflies.

Eighteen hundred and five species of butterflies are enumerated in the work as occurring within the region, three hundred and sixty of them being described as new to science. Of these species about twelve hundred and fifty are figured in the one hundred and thirteen hand-colored plates drawn by Rippon and by Purkiss. It will be seen from the foregoing statement that the region chosen is far richer in the number of the species of Rhopalocera than the continent of North America north of Mexico or the Palæarctic region, the latter covering Europe and northern Asia. The last published list of the diurnal lepidoptera north of Mexico cites but six hundred and forty-five species, a few of which, however, are doubtful, to which must be added a few others recently described. There are probably not more than seven hundred valid species of butterflies to be found on the entire continent of North America from Florida and the Rio Grande of Texas to the Arctic Ocean. Staudinger & Rebel's Catalogue, which has just appeared, enumerates seven hundred and sixteen species as found in the Palæarctic region, covering the Barbary States, Europe, Asia Minor and temperate Asia north of the Himalayan ranges. Within the comparatively small area of Mexico and Central America more species of butterflies occur than are found in all temperate North America, Europe, North Africa, and temperate Asia put together.

Compared with the fauna of the West Indian Islands so far as known, the latter are exceedingly poor in the number of genera as well as species of butterflies. While strictly correct lists of the species of Rhopalocera found on the various West Indian Islands are not available for purposes of comparison, enough is positively known to make it certain that all of these islands together do not contain more than one third of the number of species which are accredited to the region covered by the 'Biologia.' In fact, it is doubtful whether these islands have more than one fourth as many species as are found in the territory of which we are speaking, provided the Leeward Islands and Trinidad be excluded, as appears to the writer proper, in view of their close contiguity to the South American mainland.

An examination of the exceedingly interesting table given in the introduction to the work, which is devoted to the display of the geographical distribution of the various species, shows that the region in and about Panama is probably the most prolific, Costa Rica and Guatemala following closely. It is here, in the humid tropical forests, that we have the fullest development of the Rhopalocerous fauna of the territory. The table of distribution is summarized as follows:

Nymphalidæ, ...	588	species
Libytheidæ, ...	1	"
Erycinidæ, ...	240	"
Lycaenidæ, ...	234	"
Papilionidæ, ...	186	"
Hesperiidæ, ...	556	"
Making a total of.....	1805	"

Comparing this list with the great list of the 'Rhopalocera Ethiopica,' recently published by Professor Aurivillius, and adding the Hesperiidæ from the Ethiopian subregion, which number about three hundred and seventy-five species, we find that the continent of Africa and the adjacent islands have up to the present time only yielded us about two thousand species of Rhopalocera. It is evident, therefore, that the Neotropical region, which includes tropical South America as well as Mexico and Central America, is likely to prove to possess, when a final and exhaustive catalogue of the species is made, the richest Rhopalocerous fauna in the world. The family of the Hesperiidæ is far richer in species in this region than anywhere else. More species of these interesting and often puzzling insects occur in Mexico and Central America than are found either in the tropics of the Indo-Malayan region or in the tropics of Africa. The Erycinidæ are also characteristic of the region, and the number of species of this family in the total vastly exceeds the number of species found in all other regions of the globe combined. The Nymphalidæ lead all other families in the number of species, but the number of species, while great, is not equal to the number that is found in the Ethiopian subregion, nor is the number of species as great as that known to occur in the Indo-Malayan subregion.

The general conclusions reached by Mr. Godman as to the distribution of species within the territory are best expressed in his own language. He says: "Our study of the Central American butterflies proves conclusively (1) that the fauna is mainly a northern extension of that of tropical South America, extending on the Pacific side to Mazatlan and on the Atlantic to a little beyond Ciudad Victoria in Tamaulipas, some few species on each coast reaching the southern United States, with, of course, many peculiarly modified forms in the region; (2) that there are a considerable number of Nearctic genera and species coming down the central plateau a certain distance into Mexico, and some even into Guatemala, as *Argynnis, Vanessa, Limenitis, Grapta,* various *Colias,* etc.; (3) that there are no strictly alpine forms, the insects met with above the tree-line being mostly stragglers from below, such species as occur at the highest limits of the forest being very like those of similar Andean localities, these mostly belonging to the genera *Euptychia, Archonias, Catasticta, Pereute, Enantia,* etc.; (4) that the fauna of the Atlantic slope to perhaps as far south as Costa Rica is incomparably richer than that of the Pacific, this being particularly noticeable in the Ithomiina, the Erycinidæ, the genera *Thecla* and *Papilio,* etc.; and (5) that some of the purely tropical genera do not reach north of Nicaragua, Costa Rica or Panama, as *Eutresis, Scada, Cœrois, Callitœra, Hetœra, Oressinoma, Narope, Panacea, Megistanis, Hypna, Zeonia, Ithomeis,* etc."

Within the limits of a brief review such as this it is impossible to take up and consider many of the interesting details in reference to distribution which present themselves to view upon a careful study of the work. The writer commends to the careful attention of all students of entomology the introductory chapter of Volume I., which epitomizes in a masterly manner the results of the years of study which have been devoted by the learned authors to the subject in hand. To the comparatively few who are devoting themselves to a critical study of the Hesperiidæ that portion of the work devoted to this family is of extreme value. It is no exaggeration to say that it is one of the most perfect examples of careful monographic work which has ever appeared in the English language. The amount of painstaking and microscopic research which has been performed in order to attain the results which are given has been prodigious. It is certainly to be hoped that the work will find a place in all the great libraries of the New World, for without access to it the student of entomology in America is certain to find his labors greatly retarded.

W. J. Holland.

Carnegie Museum, Pittsburgh.

A Laboratory Course in Bacteriology, for the use of Medical, Agricultural and Industrial Students. By Frederic P. Gorham, A.M. Philadelphia and London, W. B. Saunders & Co. 1901. 8vo. Pp. 192.

In this unpretentious laboratory guide the author has succeeded in combining technical accuracy with sound pedagogy in a manner which will commend the book to teaching bacteriologists. The directions for even the commonest processes have very obviously stood the test of actual use with classes before being crystallized into their present form. The particular merit of the book lies in the fact that the author has carefully described small points of technique which too many others writers have left for the student to learn for himself through experience more or less bitter.

The contents of the book are as follows: Chapter I., Microscopical Examination of Bacteria, with a description of the ordinary processes of staining; II. and III., Morphology and Reproduction, with methods of straining flagella and capsules; IV., Classification of Bacteria—a synopsis of Migula's genera; V. and VI., Sterilization, and Preparation of Culture media; VII., Cultures of Bacteria—a description of the ordinary culture methods, with full tables of descriptive terms; VIII., Determination of Species, contains a list of diagnostic characters, a standard chart for full description of a species, a key for tracing the more common forms, and a synopsis of Chester's scheme of classification by groups; IX., Bacterial Analysis of Water, Milk, Air and Soil; X., Pathogenic Bacteria—directions for the study of eleven typical pathogenic organisms. The appendix contains an account of Wilson and Randolph's method of measurement by photography, a description of the common contaminating moulds and yeasts, and a very useful list of synonyms.

Not a few points and methods are described which have hitherto appeared only in monographs; some are here published for the first time. The text is fully illustrated, and many of the cuts are new.

On account of its thoroughly modern and in many respects original treatment of the ordinary technique of bacteriology this book will prove useful not only to the bacteriologist, but to the botanist who employs bacteriological methods in pathological or systematic work.

HAVEN METCALF.
THE UNIVERSITY OF NEBRASKA.

SOCIETIES AND ACADEMIES.

THE GEOLOGICAL SOCIETY OF WASHINGTON.

THE 122d meeting of the Society was held on Jan. 8. The first paper was by Mr. Charles D. Walcott on 'The Outlook of the Geologist in America.' This was the substance of the presidential address, before the Geological Society of America, at Rochester.

Mr. M. R. Campbell then presented a paper on 'Recent Geological Work in Pennsylvania.' The author summarized briefly the character and scope of the mapping of the Pennsylvania coal fields which is now being carried on by the United States Geological Survey in coöperation with the State. Up to the present time seven quadrangles, embracing an area of 1,600 square miles in the bituminous coal fields, have been geologically surveyed.

It is generally admitted that the weakest point of the Second Geological Survey of Pennsylvania was its lack of adequate base maps on which to portray the geological data gathered in the field. It was impossible to locate geological boundaries correctly upon the crude county maps, which were the only ones available. With the aid of the recent detailed topographic maps, it is believed that the geological boundaries have been determined within an error of a few feet. The importance of such close mapping is self-evident from the fact that land underlain by the Pittsburg coal is valued at from $300 to $1,100 per acre. The investigations have also brought out many details of structure not previously known, which are of the utmost importance to mine and oil and gas well operators. In closing Mr. Campbell expressed a high appreciation of the labors of the geologists who had preceded him in this field, and stated that their results can only be superseded by the most careful detailed work and by the use of a topographic base map producing a high degree of accuracy.

ALFRED H. BROOKS,
Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON.

THE 347th meeting was held on Saturday evening, January 11.

F. A. Lucas exhibited a malformed tooth of Mastodon, of an irregular shape, and with about twice the normal number of cusps, the extra cusps having been mostly added on one side of the tooth.

M. B. Waite presented 'A Problem in Plant

Pathology and Physiology,' stating that last fall he had been called upon to examine a large pear orchard belonging to Mr. A. S. Newson of Algoa, Texas, that was said to be suffering from the effects of blight. On examination it was found, in addition, to be suffering from leaf blight, from lack of cross fertilization and from unfavorable environment, having been planted on prairie soil without any proper natural drainage. Steps had been taken to combat the pear blight, but the result was very doubtful, as the disease could be readily brought in from surrounding orchards. The leaf blight could be remedied by spraying and the cross fertilization supplied by planting other varieties of pear, but it remained to be seen whether or not the locality was too far south for the successful cultivation of pears. These trees, like the peach, needed the rest gained by lying dormant during cold weather.

Wilfred H. Osgood spoke of 'The Supposed Occurrence of Caribou on the Queen Charlotte Islands,' saying that a new species, *Rangifer dawsoni*, had been described on the strength of a single imperfect skull, said to have been brought from Graham Island. Mr. Osgood reviewed the evidence relating to this skull and read extracts from a number of letters concerning it, concluding that in all probability caribou had never been seen in that locality.

Jacob Kotinsky read a paper on 'Present Opinion concerning the Home of the San José Scale,' briefly reviewing the history of the pest from the time of its appearance in California and the attempts to find its original habitat. It was supposed quite recently that Japan was the native place of the scale, but investigation showed that it did not occur in elevated portions of Japan, nor on native trees, while Mr. Marlatt had subsequently located it in China, south of the Great Wall.

F. A. LUCAS.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 31st annual meeting was held Dec. 21, 1901, President Walcott in the chair.

The report of the secretaries was presented by Mr. J. F. Hayford. During the year the principal event has been the incorporation of the Society; 16 meetings have been held for the presentation of papers; Vol. XIII. of the *Bulletin* has been completed and distributed, and 78 pages of Vol. XIV. At present the *Bulletins* are sent regularly as issued to about 300 societies, libraries, etc. A tabulation of the membership for about 20 years, during which time several other scientific societies have been formed at Washington, showed that the loss in membership due to these had now ceased and the Society has reached a steady regime. The present membership is 107. The treasurer's report presented by Mr. B. R. Green showed a healthy financial condition.

Mr. Richard Rathbun, Assistant Secretary of the Smithsonian Institution, was elected President for 1902, and the other officers were reelected.

The 544th meeting was held Jan. 4, 1902.

Mr. D. B. Wainwright, of the Coast and Geodetic Survey, described the experiments made in October last between Nantucket Light ship and the shore, a distance of 48 miles, by the aid of the Marconi apparatus in regular use there, to determine 'Longitude by Wireless Telegraphy.' It was found possible to secure chronograph records of the chronometer beats and the signals from the ship, and then to eliminate the lag of the instruments by causing the chronometer-break to excite the coherer and obtain new chronograph records. Time observations were made and the data were obtained for what is probably the first determination of longitude by wireless telegraph. In the discussion that followed, participated in by several geodesists, the opinion was expressed that even for the short distances through which the new method could now be used, the precision of observation was greater than that of any other method except the telegraphic; its special value would probably be found in work among islands and in unsettled countries like Alaska.

Professor Updegraff then discussed the 'Stability of Astronomical Piers.' The first astronomical instrument was only a pier, the Gromon; and by its aid the ancients determined a surprisingly large number of constants. A pier should be built on soil rather than on rock; brick was now in favor rather than stone: at the Cape of Good Hope the piers of the meridian circle were iron cylinders filled with water. At the Naval Observatory the marble piers of the six-inch meridian circle had shown a change in azimuth of 0″.3 for 10° Fahr., and had recently been replaced by brick.

CHARLES K. WEAD,
Secretary.

NEW YORK ACADEMY OF SCIENCES.
SECTION OF BIOLOGY.

A REGULAR meeting of the Section of Biology was held on Dec. 9, Professor Bashford Dean presiding. The following papers were presented:

'The Action of Alcohol on Muscle': F. S. LEE and W. SALANT.

'Instincts of Lepidoptera': A. G. MAYER.

'The Natural History of some Tube-forming Annelids': H. R. LINVILLE.

The first paper, presented by Professor Lee, consisted of an account of an investigation carried out by the two authors jointly, by very exact methods, pure ethyl alcohol being used, and isolated muscles of the frog in the normal and in the alcoholized condition being compared. It is found that the muscle which has absorbed a moderate quantity of pure alcohol will contract more quickly, relax more slowly, perform a greater number of contractions in a given time, and become fatigued more slowly than a muscle without alcohol. The effect is most pronounced in from one half to three quarters of an hour after the liquid has begun to be absorbed, and later diminishes. Whether the alcohol exerts this beneficial action upon the muscle substance itself or on the nerves within the muscle is not yet certain. The results allow no conclusion regarding the question whether the alcohol acts as a food or in some other manner. In larger quantities its presence is detrimental, diminishing the whole number of contractions, inducing early fatigue, and diminishing the total amount of work that the muscle is capable of performing, even to the extent of abolishing the contractile power entirely. In such quantities the action is distinctly poisonous. The after-effects of either small or large doses have not yet been studied.

Dr. Mayer reported upon a number of experiments designed to determine the nature and duration of associative memory in lepidopterous larvæ. In one series the larvæ were placed in a wooden box divided into two compartments by a central partition, which was pierced by a small opening. On one side of the partition was placed moist earth containing growing food-plants, while the other chamber was barren. The larvæ were placed in the latter and found their way through the opening to the food. Apparently they never learned the path to the food, but always wandered aimlessly about, never shortening their paths. When the food was removed, however, they rarely entered this side of the box, showing that it was the presence of the food that attracted them. Individual temperament is very well shown by the larvæ, for some quickly find the food, while others are much slower. This quickness is not due to superior intelligence, however, but is owing to the fact that these larvæ remain quiet for shorter periods of time than the slower ones. A number of experiments were made upon larvæ which devour only special kinds of leaves. These can be induced to eat sparingly of previously uneatable food if the sap of their proper food-plant be rubbed into the previously distasteful leaves. Similarly, they can be prevented from devouring their proper food-plant if the juices of uneatable plants be rubbed into the substance of the leaves. However, they can always be induced to bite at or devour any foreign substance if one allows the larva to commence eating its proper food, and then slides up in front of it a distasteful leaf, sheet of paper, tinfoil, etc. The larva will take a few bites of the foreign substance, but will soon draw back its head, snapping its mandibles with apparent disgust or aversion. Very soon, however, it recommences to eat in a normal manner. If, now, the foreign substance be presented to the larva at intervals of one and one half minutes or more, about the same number of bites is taken at each presentation, thus showing that the larva does not remember its disagreeable experience for this interval. If, however, the interval be about thirty seconds the larva will take fewer and fewer bites of the disagreeable leaf, soon refusing it altogether. Here again individual temperament is shown in the reaction of larvæ in this respect. When spinning their cocoons the larvæ of *Samia cynthia* and *C. promethea* are geotropic, for if the cocoon be inverted soon after the completion of the outer envelope, the pupæ are sometimes found reversed also, and may thus be imprisoned in the cocoon; for the densely-woven (normally lower) end of the cocoon is probably impenetrable to the issuing moth. A series of experiments are now being tried to determine whether the peculiar coloration of male moths in dimorphic species is due to sexual selection on the part of the female. In the case of *Callosamia promethea* there appears to be none, for males are accepted even when female wings are pasted upon them, or when their wings or scales are entirely removed. In the case of *O. dispar,* however, there is a decided selection against males whose wings have been cut off; 57 per cent. of the perfect males succeed in mating with the females, while only 19 per cent. of the wingless males are successful. The peculiar coloration of the males in these cases has probably not been brought about through the agency of sexual selection on the part of the female, but may be due to race-tendency toward variation in a definite direction unchecked by natural selection.

Dr. Linville, in his paper, showed that the investigation of the habits of *Amphitrite ornata* and *Diopatra cuprea* brings to light many interesting adaptations. The first named lives in U-shaped tubes in sand and mud, access to food and water being possible at either end. Additions to the tube are made at the ends by the tentacles, which are continually drawing in small masses of sand. However, there is every indication that in this animal, where no occasion exists for a protecting tube, continued tube-building is merely incidental to food-getting. Food is brought to the mouth, which is always concealed, in the masses of sand and in water currents created by the inward-lashing cilia which thickly cover the tentacles. *Diopatra* lives in a tough, mucus-lined tube, with its deeper end bare and serving as an anchor, while its outer free end is studded with bits of shell and gravel. The animal may expose its anterior portion while searching for food and for suitable material to add to its tube. Observations made in the laboratory indicate that the animal chooses these materials by tactile sense-organs in the cephalic cirri. The particle is grasped between the palps or by the mandibles, or by both, and is then conveyed with a fair degree of precision to a place at the edge of the tube. During the construction, *Diopatra* periodically ceases to build in order to 'glue' the gravel and shell together. The mucous-secreting organs are pads upon the ventral surface near the head. These organs are brought in contact with the inner surface of the tube by long and vigorous contractions and expansions of the trunk segments. All or nearly all of the newly constructed portions are gone over in this way before the animal renews its search for new bits of gravel and shell.

Henry E. Crampton,
Secretary.

THE BOSTON SOCIETY OF NATURAL HISTORY.

An interesting exhibition of lantern slides of New England Birds was given by Mr. Reginald Heber Howe, Junior, at the meeting of December 4, 1901. Among the more interesting views shown was one of a phœbe's nest built inside a barrel, and a series taken on Seal Island, Maine, illustrating the breeding-grounds and nesting-tunnels of the Leach's petrel. A unique photograph was that of a male chestnut-sided warbler standing on the edge of its nest, in the act of removing excrement of the young. A number of views were shown of ospreys' nests, some built, as along the Maine coast, in trees by the shore, others, as commonly in Rhode Island, on cartwheels, elevated on the ends of poles for the use of the birds.

At the meeting of December 18, Mr. John G. Jack gave an account of forestry and grazing in the Bighorn Reserve, Wyoming. The great value of the forest for holding water, and thus insuring a permanent water supply, was pointed out, and the disastrous effects of forest fires were illustrated by a series of lantern slides. Englemann's spruce and lodge-pole pine were the chief timber trees noted on the reserve. An interesting view was shown of a valley, running east and west, on whose sunny southern slope grew the *Pinus flexilis,* while the cooler slope with the northerly exposure supported a growth of Englemann's spruce. A view of especial interest was shown, of a group of trees on whose sides were long and deep-worn scars, made years before and partially healed over, where elk had persistently rubbed their antlers while in the velvet.

Mr. Henry L. Clapp gave an account of school gardens in Europe and in this country. There are in Europe over 80 such gardens, from Sweden to Switzerland. The methods of laying out the gardens, preparing the soil, and planting of the flowers and vegetables by the children were explained by the speaker and illustrated by a fine series of lantern slides. Only recently has this practical and interesting method of teaching botany to children been introduced into this country, but the results have already been noteworthy, and more such gardens should be established for our own schools.

GLOVER M. ALLEN,
Secretary.

THE KANSAS ACADEMY OF SCIENCE.

THE Kansas Academy of Science held its thirty-fourth annual meeting at Iola, Kansas, on December 30 and 31, 1901, Professor E. Miller, of the Kansas State University, in the chair. While the meeting did not have an attendance equal to that of some former years, there was much interest manifested in its work and an unusually full program presented. Fourteen new active members were elected, and seven active members advanced to life membership. About forty papers, mainly on biological, geological and chemical topics, were presented, many of the more technical ones being read by title only.

A paper by Professor J. T. Lovewell, formerly chemist in Washburn College, Topeka, on 'Gold in Kansas Shales,' provoked considerable discussion. The author announced as the result of a very large number of assays, that gold in paying quantities exists in the vast beds of shales which cover such a large section of western Kansas. The chemists and geologists of the State University and many others have positively denied that gold exists in these shales. A warm discussion followed the reading of the paper, with the result that the Academy appointed a commission of three of its members to investigate the matter further, and to report at the next meeting of the Academy.

On Tuesday evening, December 31, President Miller gave the retiring president's annual address, choosing for his topic, 'The Growth of Science during the Nineteenth Century.'

'A New Plesiosaur' was described by Dr. S. W. Williston, of the State University. The remains of this animal, as well as those of many others, were discovered during the past season by Mr. Charles H. Sternberg, of Lawrence. Mr. Sternberg spent several months in the field, part of the time in the employ of a noted foreign museum, which thus obtained many of his most valuable discoveries. He read before the Academy an interesting paper on 'The Permian Beds of the Big Wichita Valley of Texas.' At the conclusion of his paper much interest was manifested in deploring the loss of these rapidly disappearing paleontological specimens to American institutions, and especially to those of Kansas. A lack of funds for employing explorers or buying the specimens is responsible for this condition.

The members of the Academy were shown every courtesy by the people of Iola, who interested themselves in showing their visitors through the vast industrial plants located there. These include several large zinc smelters, an acid manufactory, cement works, etc., all made possible by the vast field of natural gas which underlies this beautiful part of Kansas.

The following is a list of the officers for the ensuing year: President, J. T. Willard, of the State Agricultural College, Manhattan; First Vice-President, Edward Bartow, of the State University, Lawrence; Second Vice-President, J. A. Yates, of Ottawa University, Ottawa; Secretary, G. P. Grimsley, of Washburn College, Topeka; Treasurer, E. C. Franklin, of the State University.

The next annual meeting will be held in Topeka.

D. E. Lantz,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

At the meeting of the Academy of Science of St. Louis on the evening of January 6, 1902, about forty persons present, the following officers for 1902 were installed: President, Henry W. Eliot; Vice-Presidents, D. S. H. Smith, William E. Guy; Recording Secretary, William Trelease; Corresponding Secretary, Ernest P. Olshausen; Treasurer, Enno Sander; Librarian, G. Hambach; Curators, G. Hambach, Julius Hurter, Hermann von Schrenk; Directors, Amand Ravold, Adolf Alt.

On behalf of herself and a considerable number of other persons, Mrs. William Bouton presented to the Academy a collection of 633 butterflies mounted on Denton tablets, on condition that the collection should be made accessible to the public.

The following papers were presented by title:

'New Species of Plants from Missouri': K. K. Mackenzie and B. F. Bush.

'Revision of the North American Species of Triodia': B. F. Bush.

Professor A. S. Chessin exhibited a gyroscope and explained how an accurately constructed and rapidly rotated gyroscope might be made to indicate the position of the meridian plane, the direction of the polar axis of the earth and the latitude of the place of observation, thus serving the purpose of the mariner's compass, but more accurately, because of the fact that the compass indicates the magnetic pole and not the true pole. The following formulæ pertaining to the subject were furnished:

$$T=\pi\sqrt{\frac{A+C_1+A_2}{C\omega\Omega\cos\lambda}}\qquad T'=\pi\sqrt{\frac{A+C_1+A_2}{C\omega\Omega}}$$

where T and T' are the durations of a complete oscillation of the gyroscope when its axis is made to remain in the horizontal and the meridian planes, respectively; ω and Ω the angular velocities of rotation of the earth and the gyroscope, respectively; A, A_1, A_2 and C, C_1, C_2 the equatorial and the axial moments of inertia of the gyroscope and the two rings on which it is mounted. From these formulæ the latitude (λ) of the place of observation is derived, namely:

$$\cos\lambda=\frac{T'^2}{T^2}.$$

Professor F. E. Nipher made a further statement concerning his results in the attempt to produce ether waves by the explosion of dynamite. He had obtained some results which seemed to show that magnetic effects could be thus produced. "There is apparently no doubt that great solar outbursts like the one which Professor C. A. Young saw at Sherman in 1872* produce enormous distortions of the ether. Why should it not be possible to reproduce this result? It goes without saying that large sun-spots may be slowly formed, without such ether disturbance; and certainly we can hardly expect to reproduce solar velocities. But terrestrial explosions do yield tremors and sound vibrations, and these lead to experimental difficulties. The nickel-silver coherer can be operated by the sound-waves from a tuning-fork. The coherer can be either opened or closed, by sound-waves, when the coherer is properly placed in a magnetic field. The same result may be produced by changes in the magnetic field, due to the slow approach of a horseshoe magnet. After the coherer circuit has been closed by a spark, the slow approach of a horseshoe magnet will often open the circuit, precisely as it does when the coherer has been closed by the magnet held in a position of reversed polarity. When the magnet fails to open the coherer circuit, the cause is either a too rapid approach, which causes the coherer to close by reversal of magnetic polarity, or a wrong presentation of the magnet, which confirms the condition produced by the spark discharge. The conditions under which experiments are made as yet, with the jarring due to the street traffic and the explosions, and the changing magnetic field due to the electric cars, have proven to be a source of some perplexity. It throws some doubt

*'The Sun,' p. 156.

upon the results reached. However, there seems to be a residual effect which cannot thus be accounted for, and it may be due to an ether displacement. This matter is being carefully studied, and it is intended to use more violent explosives."

WILLIAM TRELEASE,
Recording Secretary.

DISCUSSION AND CORRESPONDENCE.

AN AMERICAN GEOGRAPHICAL SOCIETY.

As has been announced, the next meeting of the International Geographical Congress is to be held in Washington, D. C., in 1904. It must be apparent, I think, to every one familiar with the status of geography in America, that we are not prepared for such an invasion, and that a better organization of our geographical ranks is highly desirable.

There are now at least ten geographical societies in the United States. How many more there are in other parts of the two Americas I am not informed. Each of these societies is a local organization and there is no tangible bond of union between them. It needs no argument to show that some form of cooperation or of union between these various societies is much to be wished, not only that we may make a creditable showing at the coming meeting of the International Congress, but what is much more important, in order that mutual assistance may be had, and the science of geography advanced in a more efficient way than is practicable at present. This matter is not new, and at the risk of seeming to assume undue responsibility, I venture to state a plan of reorganization which embodies ideas gathered from various sources.

My thesis is: There should be an American Geographical Society having for its territorial limits the New World. The aims of this society should be in the main threefold:

1st. The holding of a general meeting each year, preferably during convocation week.

2d. The publication of an illustrated monthly magazine, devoted to geography in its widest aspects.

3d. The promotion of geographical exploration and research.

In reference to the first of these aims, I need not enlarge on the desirability of an annual meeting at which the results reached by various students of geography may be presented and discussed, and acquaintances made or renewed, since abundant justification for such a course is known to every one, from the success that has attended the annual meetings of several national and international scientific organizations during the past decade. Geographers certainly need to know their fellow workers as much as geologists, chemists, etc., need to know each other. This would be one of the chief results of an annual meeting of geographers, held perhaps at the same time and place as the annual winter meeting of the Geological Society of America.

The greatest gain to be expected from the proposed reorganization lies in the second of the aims to be fostered by the new society, namely, the publication of a strong, attractive, well-illustrated monthly magazine, in the place of the several publications now issued by existing societies. Some of the reasons for this are: The saving of expense in editing, and in duplication, especially of news items, reviews, etc.; concentration and ready reference. The concentration of American geographical literature would be a blessing to future generations, in view of the fact that complete files of the present publications are not readily accessible, and to find all of them in one library is seldom possible. With a central bureau of publication, also, it is to be hoped that the standard of the articles published would be higher. While the expense of a monthly magazine representing the interests of all classes of geographers, and well edited and well printed, would perhaps be greater than that of any one of the single publications referred to, it would be much less than all of them combined. It would also, I venture to assert, reach a wider audience than all of the publications combined which it would replace. Such a magazine would place American geography in a far more favorable light than it now enjoys, in the eyes of the geographers of other continents.

While a few of the existing societies have assisted in geographical research, their efforts have been local and the results attained, while creditable, have not been such as could be legitimately expected from a stronger and more widely extended organization. With all geographers in America united, influence in favor of exploration could be brought to bear upon legislative bodies which would command attention.

PLAN OF REORGANIZATION.

To attain the desirable ends referred to above, the following plan for uniting the existing geographical societies into one organization, with power to increase its membership and broaden its efficiency, is proposed for discussion:

Let each of the existing societies become a section of the new organization to be known as the American Geographical Society. Each section to manage its own affairs, independently, have its own officers, its own property, etc., but pay a sum, in proportion to its membership, in support of the magazine to be published by the united sections.

All members of the various sections to be fellows of the larger organization, and at their annual meeting to elect a president, secretaries, treasurer and editor. The president of each of the various sections to be ex officio vice-president of the main society.

The various sections to choose their own names, but it is to be hoped these names would be geographical, as for example, Boston Section, New York Section, Washington Section, San Francisco Section, etc., of the American Geographical Society. Such a broadening and enlargement of aims would be a compliment to the Society now bearing the name which it is desirable should be given to the representative Society of the two Americas.

The arguments for a truly American geographical society are far greater than I have attempted to show. The objections to the plan outlined seem to refer entirely to local pride or, more accurately, local self-interest. That the existing societies should be proud of the results they have attained and love their present methods is not only natural, but commendable. A broader view, however, must convince one that each local society by union with all other similar societies in America, without losing its own individuality, would bring to itself renewed strength and vigor.

My aim in presenting this outline of a method by which all students of geography in America may be induced to cooperate and mutually assist in enlarging the boundaries of geographical knowledge, is to invite discussion. I am sure that the editor of SCIENCE will give space for the expression of the opinion of any one in this connection. I wish especially to invite the Council of each existing society to discuss this matter and express its views. If we can arrange for a meeting of delegates from each society, a mutual agreement beneficial to all can no doubt be reached. This should be done in time to effect a reorganization before the convening of the International Geographical Congress.

ISRAEL C. RUSSELL.

ANN ARBOR, MICH.,
Jan. 13, 1902.

THE INTERNATIONAL CENTRALBLATT FOR BOTANY.

As we have already noted the president of the *Association Internationale des Botanistes* has appointed the following American editors for the *Botanisches Centralblatt:*

D. H. Campbell, Stanford University, California, 'Morphology.'

C. J. Chamberlain, University of Chicago, 'Cytology.'

D. T. MacDougal, New York Botanical Garden, 'Physiology.'

G. T. Moore, Department of Agriculture, Washington, D. C., 'Algae, Lichens, Archegoniates' (systematic).

D. P. Penhallow, McGill University, Montreal, 'Paleobotany.'

H. von Schrenk, Washington University, St. Louis, Mo., 'Fungi (systematic) and Vegetable Pathology.'

Wm. Trelease, Missouri Botanical Garden, St. Louis, Mo., 'Phanerogams' (systematic).

For the coordination of the editorial work, the two editors last named have been asked to serve respectively as secretary and chairman of the American Board.

Professor William Trelease, chairman of the Board has sent out the following directions, which we quote as of interest to all workers in science.

In order that the *Centralblatt* may be given the greatest possible value for American botanists and that the least possible delay may be experienced in securing the publication of abstracts of American papers, the authors of such papers are requested to promptly send copies of the same (marked 'for review,' if convenient) to the editor in charge of the subject dealt with in each paper, or, if authors' separates are not available, to call the appropriate editor's attention to the paper.

Each editor is requested to make a regular examination of current journals, proceedings of societies, etc., for papers dealing with his subject, so that occasional failure to receive an author's separate may not deprive the users of the *Centralblatt* of prompt reviews of all papers published in this country. In case an editor has not regular access to any specified serial publication, the chairman will keep him informed as to its contents, if asked to do so. Each editor is requested to consider the subject assigned to him in the broadest possible sense, and, in case of a paper doubtfully lying in his field, to err on the side of noticing it rather than in the other direction, or to specifically refer it to the editor to whom, in his judgment, it should go, or to the chairman of the board.

The management of the *Centralblatt* asks that abstracts (which may be in English), rather than commendatory reviews, be prepared; that the more important publications be first noticed, title and place of publication of current papers not reviewed being likewise sent in; and that attention be given to *quality, promptness* and *brevity,* in the sequence indicated, in the preparation of abstracts.

The chairman of the American Board suggests, with endorsement of the preceding paragraph, that his colleagues adopt the general form and marking for printers of the accompanying model,* in the heading of abstracts, following the Madison rules for abbreviations when such are considered necessary; that names of all new genera, species and varieties (which, like latinized names in general, should be italicized) be included in abstracts of systematic papers; that especial care be given to legibility, punctuation and the spelling of geographic and scientific names and technical words, and that 'copy' and entries for papers not reviewed be sent to the chairman regularly at the end of each week, a memorandum of postage and other necessary expense being kept and sent in at the end of each quarter year.

The editor of the *Centralblatt* desires to have each abstract signed by the person who prepares it, and, subject to approval and correction of reviews before transmittal to the chairman, each editor has the privilege of assigning any papers in his department to suitable persons, in case he does not wish to abstract them himself.

* CAMPBELL, D. H. 'On the affinities of certain anomalous dicotyledons.' (American Naturalist, 36: 7–12. *f. 1–2.* Jan., 1902.)

SCIENTIFIC NOTES AND NEWS.

AT a recent meeting of the American Academy of Arts and Sciences of Boston, the following were elected: E. B. Wilson of New York, as associate fellow; Julius Hann of Vienna, E. R. Lankester of London, V. A. H. Horsley of London, F. Delitzsch of Berlin, and S. R. Gardiner of Sevenoaks as foreign honorary members.

JOHNS HOPKINS UNIVERSITY will celebrate on February 21 and 22 its twenty-fifth anniversary, when President Remsen will be formally inaugurated. Dr. D. C. Gilman, president emeritus, will deliver the commemorative address in the afternoon of Feb. 21. This will be followed by an official reception to the delegates, and at eight o'clock in the evening there will be a general reception. President Remsen will make his inaugural address on Feb. 22, in the afternoon. In the evening the annual banquet of the Alumni Association will be held.

THE medals and funds of the Geological Society of London will this year be awarded as follows: The Wollaston medal to M. Friedrich Schmidt of St. Petersburg, the Murchison medal to Mr. F. W. Harmer, and the Lyell medals to Mr. R. Lydekker and Professor Anton Fritsch, of Prague; the Wollaston fund to Mr. L. J. Spencer, the Murchison fund to Mr. T. H. Holland, the Lyell fund to Dr.

Wheelton Hind, and the Barlow-Jameson fund to Mr. W. M. Hutchings.

Dr. Eugen Warming has been appointed director of the Geological Survey of Denmark.

Professor J. H. Marshall, who has recently been engaged in archeological researches at Athens, has been appointed director-general of the Archeological Survey of India.

We learn from the *American Anthropologist* that a committee has been appointed at the instance of the Société d'Excursions Scientifiques, to solicit funds for the erection in Paris of a monument in honor of the late Gabriel de Mortillet. Favorable response is being made, and the names of a number of American subscribers appear in the printed list distributed by the committee. M. Louis Giraux, 22 rue Saint Blaise, Paris, is the treasurer.

We learn from *Nature* that a medallion bust of Sir George Airy is to be placed in the northeast wall of St. Alphage Parish Church, Greenwich, by his daughters. The bust has been copied from the one in the Royal Observatory, Greenwich.

Dr. William LeRoy Broun, president of the Agricultural and Mechanical College of Auburn, Ala., died on January 23.

Professor Emil Scheffer, a chemist, died at Louisville, Ky., on January 22, at the age of ninety years.

Dr. Hugo von Ziemssen, the eminent German pathologist, professor in the University at Munich, died on January 20, at the age of seventy-two years.

Mr. Charles Roberts, a British surgeon and the author of contributions to anthropometry and natural history, died on January 8.

The annual meeting of the board of regents of the Smithsonian Institution was held on January 22. There were present Chief Justice Fuller, chancellor, in the chair; William P. Frye, president pro tempore of the United States Senate; Senator S. M. Cullom, Senator O. H. Platt, Senator F. M. Cockrell, Representative Robert Adams, Jr., Representative Hugh A. Dinsmore, Dr. J. B. Angell, Richard Olney, George Gray, J. B. Henderson, Dr. Alexander Graham Bell and Secretary Langley. Dr. Andrew D. White, ambassador at Berlin, and Representative R. R. Hitt were unable to be present. The secretary presented his annual report for the fiscal year ending June 30, 1901, of which we hope to give some account when it has been published. The needs of the United States National Museum were considered and a resolution was adopted providing for a committee, consisting of six members of the board, whose duty it shall be to represent to Congress the pressing necessity of additional room for the proper exhibition of specimens belonging to the National Museum, and of additional appropriations to carry on the work of the museum. The chancellor appointed as members of the committee Senators Platt, Cullom and Cockrell and Representatives Hitt, Adams and Dinsmore.

It is said that M. de Witte, the Russian minister of finance, has drawn up a decree making the metric system obligatory in Russia. The decree is now under the consideration of the Imperial Council.

Major Ronald Ross announces that Dr. Dutton has found a new kind of parasite, which causes fever in human beings. The parasite is said to be like the one which causes the fly disease among horses in South Africa.

The Department of Superintendence will hold its annual meeting at Chicago on February 26 and 27 under the presidency of Mr. G. R. Glenn, state school commissioner of Georgia. Among the papers to be read and discussed are: 'Obstacles to Educational Progress,' Paul H. Hanus, professor of theory and practice of education, Harvard University; 'The Danger of using Biological Analogies in Reasoning on Educational Subjects,' Dr. W. T. Harris, U. S. Commissioner of Education, Washington, D. C.; 'The High School as the People's College versus Fitting Schools,' Dr. G. Stanley Hall, president of Clark University, Worcester, Mass. Evening addresses will be made by Dr. F. W. Gunsaulus, president of the Armour Institute, Chicago, Ill., and Dr. Charles W. Dabney, president of the

University of Tennessee, Knoxville, Tenn. The National Society for the Study of Education, of which President Nicholas Murray Butler of Columbia University is president, will meet in conjunction with the Department of Superintendence on February 27 and 28.

THE ninety-sixth annual meeting of the Medical Society of the State of New York was held at Albany on January 28, 29 and 30, 1902, under the presidency of Dr. Henry L. Elsner of Syracuse.

THE conference of science teachers, which has been arranged in recent years by the Technical Education Board of the London County Council, was held on January 9 and 10, with about 400 teachers in attendance.

THE twenty-third annual meeting of the German Balneological Congress will be held this year at Stuttgart from March 7 to 11, under the presidency of Professor Oscar Liebreich.

THE eleventh Congress of Russian Naturalists and Physicians was opened at St. Petersburg on January 2. We learn from *Nature* that the number of people taking part in the Congress was very large, more than 3,250 members' tickets having been taken on the day of opening. The Minister of Public Instruction has given a sum of 500*l*. to defray the expenses of the Congress, and both the municipality of St. Petersburg and the university have contributed large sums for the same purpose. At the first general meeting of the Congress, the president (Professor Menschutkin) spoke about the foundation of a Russian Association for the Advancement of Science, which would hold regular congresses every year. This proposal was accepted by a congress held eleven years ago; but the Ministry of Public Instruction was hostile to the idea, and only now the new Minister, General Vannovsky, has agreed not to oppose it. At the same general meeting Professor S. M. Lukianoff delivered an address on the limits of cytological research under normal and pathological conditions, in which he endeavored to establish the limits of psycho-physiology; and Professor N. A. Umoff delivered a brilliant address on a physico-mechanical model of living matter.

PLANS are being made for the establishment of a national institute of hygiene in Spain. The State has offered a site for the building, and it is hoped that sufficient funds will be raised by public subscription.

THE *British Medical Journal* states that an institute for the application of the light treatment has been established in Vienna. At a recent meeting of the Medical Society of that city Professor Lang announced that, in conjunction with a number of medical practitioners and philanthropists, he had founded an institute on the model of that of Professor Finsen at Copenhagen. The institute would be to a certain extent under the control of the municipality. Among the founders is the Emperor, who has contributed 10,000 crowns.

MR. CHARLES T. HAM has presented $5,000 to the Rochester Academy of Medicine, to be used to further medical research.

PROFESSOR J. B. SMITH, New Jersey state entomologist, expects to ask the legislature next week to appropriate $10,000 for the investigation and extermination of the New Jersey mosquito.

WE called attention recently to the Woman's Table at the Naples Zoological Station, maintained by a number of women's colleges and individuals. Those desiring further information in regard to the conditions under which the table may be occupied should address the secretary, Miss Cornelia M. Clapp, Mt. Holyoke College, South Hadley, Mass.

UNIVERSITY AND EDUCATIONAL NEWS.

MR. ANDREW CARNEGIE and the descendants of Peter Cooper have respectively given $300,000 to Cooper Union, New York City, doubling the gifts made by them to the Union three years ago. The total income will now be about $90,000, which will not enable the trustees to greatly enlarge the work of the Union, but there will no longer be a deficit, and the efficiency of the work will be increased. It is said that the entire building will now be used for the work of the Cooper Union, that the salaries of the teachers will be somewhat increased, and that the work in physics and electrical engineering will be enlarged.

Chancellor James R. Day, of Syracuse University, has announced that Mr. John D. Rockefeller has given $100,000 to the university endowment fund. This insures the raising of $400,000 to meet the offer of Mr. John D. Archbald, of New York, to double that amount. Among the new buildings that will be erected will be a biological laboratory.

Through the death of Mrs. Charlotte L. Sibley Phillips Exeter Academy will receive $50,000 and the Massachusetts Historical Society $100,000.

The University of Aberdeen has received £25,000 from Lord Strathcona and £30,000 in smaller subscriptions.

Sir W. O. Dalgleish has given £10,000 to St. Andrew's University, half of which is for the new building of the Medical School.

The Drapers Company has voted a donation of £30,000 to the new University of London.

At a meeting of the executive committee of the Carnegie Trust held in Edinburgh, the secretary and treasurer submitted their reports for the period ended December 31, 1901, showing that fees have been paid by the Trust to 2,441 students, amounting to the sum of £22,941. It was arranged to hold the annual meeting of the trustees in London, at which the first report of the executive will be submitted.

The second annual court of governors of Birmingham University was held on January 8. Mr. Chamberlain, the chancellor, made an address describing the progress of the University. Plans have been drawn up for buildings to cost about $5,000,000, and three groups, to cost about $1,500,000, will be erected with the money that has been subscribed. As has been already reported, the Birmingham City Council had made a grant equal to a halfpenny in the pound on the borough rate, producing £5,750 in the financial year, and directed that a similar grant should be provided for in its annual estimates until it should otherwise order. The Staffordshire County Council had similarly identified itself with the aims of the University by making a grant of £500 a year for five years, in aid of the School of Mining and Metallurgy.

About a year ago Mr. H. Melville Hanna founded in the medical department of Western Reserve University a research fellowship for the promotion of original work in medicine, especially in physiology and pathology. Applications for the fellowship are now invited. The income of the fellowship is about $600 a year. It is tenable, in the first instance, for one year, but a fellow who has done exceptionally good work may be reappointed for a second term. All communications should be addressed to Dr. G. N. Stewart, professor of physiology, or Dr. B. L. Milliken, dean, medical department of Western Reserve University.

Professor Edmund J. James, professor of public administration in the University of Chicago, has been elected president of Northwestern University.

Dr. R. E. Jones has resigned from the presidency of Hobart College.

Dr. Julius Sachs, head of a well-known preparatory school in New York City, has been elected professor of secondary education in Teachers' College, Columbia University.

At the January meeting of the board of trustees of Syracuse University, the following changes in the faculty of science were announced: Associate Professor H. Monmouth Smith was made full professor of chemistry. Instructor Edward H. Kraus was made associate professor of mineralogy; W. M. Smallwood, professor of biology in Allegheny College, was elected associate professor of zoology. Professor Smallwood is now on leave of absence, doing graduate work in Harvard University. He will assume the duties of his new position in September next.

At Columbia University Mr. John Cabor, Jr., M.E., has been appointed assistant in the department of physics, to succeed George B. Pegram, promoted, and Mr. Wilson E. Davis, A. B., assistant in the department of mining.

Dr. W. H. Thompson, Dunville professor of physiology, Queen's College, Belfast, has been elected to the chair of institutes of medicine (physiology and histology) in the Royal College of Physicians of Ireland, rendered vacant by the resignation of Professor J. M. Purser.

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, FEBRUARY 7, 1902.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE CARNEGIE INSTITUTION.

THE first meeting of the trustees of the Carnegie Institution was held in Washington on the 29th and 30th of January. Nearly all the members of the board were present and two sessions were devoted to a consideration of the important business entrusted to them by Mr. Carnegie. The Hon. John Hay, Secretary of State, presided on the first day and, at the second session, the Hon. Abram S. Hewitt, who had in the meantime been made permanent chairman of the board. The most interesting incident of the meeting was the appearance of the founder who in a very clear and modest way read the deed of trust by which he conveyed to the Carnegie Institution ten millions of dollars in five per cent. bonds of the United States Steel Corporation. After reading this deed, he proceeded to unfold in more familiar language the purposes that he had in view, which are not different from those already indicated, although he amplified certain points which had only been briefly mentioned before. Among other things he said in substance that he had been tempted to associate the name of George Washington with this gift of his, but on reflection he had reached the conclusion that it would be unwise to do so. He also stated that the Carnegie Institution would not be such a national university as Washington thought possible in his day. Mr. Carnegie also gave emphasis to his repeated desire that the income of the fund should be largely devoted to extending human knowledge by original investigation and research. This would involve the selection of individual co-workers of exceptional powers. It would also lead to the publication of important memoirs. Beyond these fundamental restrictions the trustees are left free to proceed as they may think best from time to time. Accordingly, an executive committee of seven persons was authorized to formulate plans and to take such preliminary steps as might be important before the annual meeting of the trustees in November next. This committee consists of the president of the Carnegie Institution, Daniel C. Gilman, the four gentlemen with whom Mr. Carnegie has been advising during the last few weeks, namely: Hon. Abram S. Hewitt, Dr. John S. Billings, Hon. Carroll D. Wright and Hon. Charles D. Wolcott, and, in addition, Hon. Elihu Root and Dr. S. Weir Mitchell. The executive committee immediately after their appointment proceeded to discuss the next step to be taken and determined to begin by opening, temporarily, rooms in Washington at No. 1439 K Street, where conferences may be held. Next they propose to correspond with men in all parts of the country who are acknowledged leaders in science (using the word science in a very broad sense), and after their answers are received to consider the suggestions they may make, preliminary to future action. They also propose to make a diligent inquiry respecting all the kindred agencies that are now promoting research under the auspices of the government or under the direction of universities and technical schools. The experience of foreign countries will also be carefully studied.

From this statement it will be obvious that the further development of this new institution will be slow and gradual. It is not expected that scholarships will be established at present, and all requests for assistance will be laid before the executive committee.

These points should be borne in mind. The great object of the foundation is the advancement of knowledge. The methods are left to the free action of the trustees, who will await the carefully matured suggestions of the executive committee. Nothing has been done in founding the new institution to further or to hinder the establishment of a national university which has been so many times proposed to Congress. Nothing is projected which will in any way interfere with the purpose of the George Washington Memorial Association to secure the funds requisite for the erection of a memorial building. Nor has there been any step taken which will prevent the Washington Memorial Institution, initiated early in the last summer, from developing plans for the introduction of students to the various scientific bureaus of Washington.

The Carnegie Institution is simply a new force for the promotion of science, ready to cooperate with other institutions which are now or may be established in Washington or elsewhere. By its very foundation it is precluded from any thought of rivalry. If the founder's hopes are realized his wise and munificent bounty will benefit not only our own country but the interests of mankind.

D. C. G.

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*THE WRECK OF MT. MAZAMA.**

INTRODUCTION.

THE geological record of this country from the earliest epochs to the present time is replete in volcanic phenomena, but the climax in such matters appears to have been reached in the earlier portion of the Neocene, when one of the largest known volcanic fields of the world was vigorously active in our Northwestern States. It stretches from the Rocky Mountains to the Pacific, embracing a large part of Wyoming, Montana, Idaho, Washington, Oregon and California, and presents a great variety of volcanic phenomena concerning which, notwithstanding a copious literature, there has been as yet but a small amount of detailed investigation. The work of the Geological Survey has taken me across this field in various directions and afforded an extended opportunity at intervals during nearly a score of summers upon the Pacific coast to study the western portion of the field. Instead of attempting a summary of what has been done in this large field, as perhaps might be expected upon this occasion, I beg to call your attention more particularly to a special feature in the volcanology of the Cascade Range, which, so far as I am aware, is not well represented in any other portion of the field nor in fact anywhere else within the United States. To set forth more clearly the wreck of Mt. Mazama, which is the central theme, it is necessary to consider briefly the general relations of the whole range.

* Abstract of Presidential address delivered before the Geological Society of Washington, Dec. 18, 1901. The full address with geological map and illustrations will probably appear as a bulletin of the U. S. Geological Survey.

LIMITS OF THE CASCADE RANGE.

The western limit of the great volcanic field is marked by the corresponding border of the Cascade Range, which is made up at least largely, if not wholly, of volcanic material erupted from a belt of vents extending from northern California to central Washington. Lassen Peak marks the southern end of the Cascade Range and Rainier is near the northern end. Beyond these peaks the older rocks rise from beneath the Cascade Range and form prominent mountains, the range itself occupying a depression in these older terranes.

FOUNDATION OF CASCADE RANGE.

A clearer conception of the development of the Cascade Range may be gained by considering the geography of the region during the later portion of the Cretaceous. At that time the coast of northern California, Oregon and Washington subsided, causing the sea to advance upon the land. In California it reached the western base of the Sierra Nevada and covered a large part, if not the whole, of the Klamath Mountains. In Washington it beat upon the western base of the range near the coast north of Mt. Rainier, but in Oregon it extended far into the interior. Marine deposits of this period occur along the base of the Blue Mountains in eastern Oregon. The Cascade Range of Oregon did not then exist to shut out the open sea from that region. East of the Klamath Mountains, as shown by the position and distribution of the Cretaceous strata and their fossils of marine origin, the open sea connected directly with that of the Sacramento Valley. The Cascade Range throughout a large part of its extent rests upon Cretaceous rocks and is associated in Oregon and California with a depression in the older rocks between the Klamath Mountains on the one hand and the Blue Mountains and Sierra Nevada upon the other. This depressed area beneath the lavas of the Cascade Range must not be regarded primarily as a region of subsidence. Its chief movement since the Cretaceous has been upward. It has been raised above the sea. The Klamath and Blue Mountains, as well as the Sierra Nevada, however, have been elevated so much more that the region in question would appear on the surface as a depression were it not filled with lava. The depression is so deep where the Cascade Range is cut across by the Klamath and Columbia rivers that the bottom of the lavas forming the bulk of the range is not reached. However, at the ends of the range the older rocks rise to form a more or less elevated base for those parts of the range, and at Mt. Shasta as well as on the divide between the Rogue and Umpqua rivers, where an arch of the older rocks extends northeasterly from the Klamath Mountains towards the Blue Mountains of eastern Oregon, the Cascade Range gets so close to the western side of the depression that the lavas lap up over the arch of older rocks rising to the westward. At various points of the range granolitic rocks, such as gabbro and diorite, occur, but the deep erosion at these points may have reached the granolites corresponding to the lavas of the upper portion of the range.

CASCADE RANGE DURING THE EOCENE.

There can be no reasonable doubt that fossiliferous Cretaceous rocks of marine origin are widely distributed beneath the Cascade Range from Lassen Peak to the Columbia, and that during the Chico epoch the whole area was beneath the sea. At the close of the Chico important changes occurred in the distribution of land and sea. Northern California, as well as southern Oregon, was raised above the sea and subjected to extensive erosion before the subsidence which admitted the sea during the early part of the Tertiary as far southeast as Roseburg, Oregon. The marine deposits of the Eocene epoch in the vicinity of Roseburg run under the Cascade Range, but have not yet been found upon the eastern side. The conglomerates of the Eocene, like those of the Cretaceous, contain many pebbles of igneous rocks, but they are of types common to the Klamath Mountains and rare or unknown among the lavas exposed in the Cascade Range. During the Eocene in the Coast Range of Oregon there was vigorous volcanic activity,* but the record of such activity, if such existed, has not yet been found in the Cascade Range. That volcanoes were active along the range during the Eocene is rendered more probable although not yet conclusive by Dr. J. C. Merriam's discovery of Eocene volcanic deposits in the John Day region.†

CASCADE RANGE DURING THE MIOCENE.

There can be no doubt, however, that during the Miocene‡ the volcanoes of the Cascade Range were most active and the greater portion of the range built up, although it is equally certain that volcanic activity continued in the same region at a number of points almost to the present time. While it may be presumed that the volcanoes of the Cascade Range are extinct, there are many solfataras, hot springs and fumeroles, showing that the volcanic energy of the range is not yet wholly dissipated.

* U. S. Geol. Survey, Seventeenth Annual Report, Part I., p. 456.

† *Bulletin Geol. Dept. of Univ. of Cal.*, Vol. 2, No. 9, p. 285.

‡ U. S. Geol. Survey, 20th Annual Report, 1898–9, Part III., p. 32.

All the peaks of the Cascade Range were once active volcanoes, and from them came most of the lava of the range. Each great volcano was surrounded within its province, at least during the later stages, by numerous smaller vents from which issued the lava that filled up the intervening spaces and built up the platform of the range.

All of the great volcanoes of the range probably had their beginning in the Miocene. Many of them, like Lassen Peak and Mount Shasta, continued their activity into the Glacial Period and have suffered much erosion since they became extinct. In this manner important structural differences have been brought to light among the peaks about the headwaters of the Umpqua, Rogue river and the Klamath, and these may be noted as throwing some light upon the history of Mt. Mazama, whose wreck we are to consider.

UNION PEAK.

Union Peak (7,881 feet) is on the summit of the Cascade Range in Oregon about 50 miles north of the California line, and 8 miles southwest of Mt. Mazama. It is a sharp conical peak rising about 1,400 feet above the general summit of the range. About the base upon the east and west sides, as well as upon its very summit, are remnants of the original tuff cone, but the mass of the peak exposed upon all sides is solid lava. The molten material did not sink away after the final eruption. The volcanic neck resulted from the cooling of lava within the cinder cone in the very top of the volcanic chimney, and Union Peak to-day shows us the neck stripped of its cinder cone.

MT. THIELSEN.

Mt. Thielsen (9,250 feet), the Matterhorn of the Cascade Range, is 12 miles north of Mt. Mazama and rises about 2,000 feet above the general summit of the range. It is built up of brightly colored red, yellow and brown layers of tuff interbedded with thin sheets of lava, and the whole is cut by a most interesting network of dikes radiating from the center of the old volcano. No trace of a volcanic neck is present; the peak is but a remnant carved out of the lava and tuff cone surrounding the vent. After the final eruption the molten material withdrew from the cone before consolidation so as to leave no volcanic neck corresponding to that of Union Peak. The subsidence after eruption within the chimney of Mt. Thielsen must have been over 1,000 feet, for the sheets of lava effused from that vent reach more than 1,000 feet above the central portion of the peak.

MOVEMENT IN MT. MAZAMA.

To simplify matters it seems best at this point to anticipate some of the conclusions to be reached and state that upon what is known as the rim of Crater Lake there once stood a prominent peak to which the name Mt. Mazama has been given. The crowning event in the volcanic history of the Cascade Range was the wrecking of Mt. Mazama, which resulted from a movement similar to that just noted in Mt. Thielsen but vastly greater in its size and consequences. It culminated in the development of a great pit or caldera, which for grandeur and beauty rivals anything of its kind in the world.

Mt. Mazama is practically unknown to the people of Oregon, but they are familiar with Crater Lake, which occupies the depression within the wreck of the great peak. The destruction of the mountain resulted in the formation of the lake, and the remnant of Mt. Mazama is most readily identified when referred to as the 'rim of Crater Lake.'

CASCADE RANGE SUMMIT.

The Cascade Range in southern Oregon is a broad irregular platform, terminating rather abruptly in places upon its borders, especially to the westward, where the underlying Cretaceous and Tertiary sediments come to the surface. It is surmounted by volcanic cones and coulees, which are generally smooth but sometimes rough and rugged. The cones vary greatly in size and are distributed without regularity. Each has been an active volcano. The fragments blown out by violent eruption have fallen about the volcanic orifice from which they issued, and built up cinder cones. From their bases have spread streams of lava, raising the general level of the country between the cones. From some vents by many eruptions, both explosive and effusive, large cones, like Pitt, Shasta and Hood, have been built up. Were we to examine their internal structure, exposed in the walls of the canyons carved in their slopes, we should find them composed of overlapping layers of lava and volcanic conglomerate, a structure which is well illustrated in the base of Mt. Mazama.

VIEW OF MT. MAZAMA FROM A DISTANCE.

Approaching Crater Lake from any side the rim by which it is encircled, Mt. Mazama, when seen at a distance, appears as a broad cluster of gentle peaks rising about a thousand feet above the general crest of the range on which it stands. The topographic prominence of Mt. Mazama can be more fully realized when it is considered as the head of Rogue River and sends large contributions to the Klamath River, besides being close to the head of the Umpqua. These are the only large streams breaking through the mountains to the sea between the Columbia and the Sacramento, and their watershed might be expected to be the principal peak of the Cascade Range.

GENERAL VIEW OF MT. MAZAMA AND ITS LAVAS.

Arriving by the road at the crest of Mt. Mazama, the lake in all its majestic beauty appears suddenly in view and is profoundly impressive. The long gentle slope upon the outside at the crest is changed to a precipice. Nearly 20 miles of irregular cliffs ranging from 500 to nearly 2,000 feet in height encircle the deep blue lake and expose in sections many streams and sheets of lava and volcanic conglomerate which radiate from the lake as a center. Along the southern border the rim above the lake level has many superimposed flows, but upon the northeast where it is not so high it is composed largely of one great flow which coursed down a ravine of the ancient Mt. Mazama.

The rim is cut by a series of eleven dikes, one of which is prominent and reaches from below the lake level to the rim crest. Others rise only part way and spread into flows for which they afforded an outlet. Near the west border of the lake is Wizard Island with its lava field and cinder cone surmounted by a perfect crater.

Three kinds of lava occur in Mt. Mazama, andesite, dacite* and basalt. The andesites form nearly nine-tenths of the mass of the rim. Dacites, generally accompanied by pumice, form the surface flows upon the north and east crest of the rim and are everywhere underlain by andesites. Both came from the central vent of Mt. Mazama, which, however, furnished no basalt. It all came from a number of small volcanic cones upon the outer base of the mountain. The dacites are younger than the basalts, for showers of dacite pumice fell in the extinct craters of the basalt cones. As the oldest lavas of Mt. Mazama are andesites, so are the latest, for the lava of Wizard Island is andesite which was poured out upon the floor of the caldera after the destruction of Mt. Mazama. It marks the beginning of a second petrographic cycle from the same vent.

* My collections were studied by Dr. H. B. Patton, who now regards as dacites what I have heretofore called rhyolites.

ORIGINAL CONDITION OF MT. MAZAMA.

Thus far the existence of an original Mt. Mazama has been assumed. The evidence on which this assumption is based may be briefly stated as follows: The inner slope of the rim presents sections of the broken lava flows which radiate from the lake and were evidently effused from a source higher in each case than the respective flow in the rim. If the flows of the rim were to be restored to their original size by extending them inwards from the rim, as they once certainly did, they would converge to a common source and make a volcano which would occupy the place of the caldera and make a prominent peak, Mt. Mazama.

The peak must have had a crater similar in character to that of Wizard Island, for it was the source of much fragmental material spread in all directions upon the mountain slope.

The former existence of Mazama Peak is indicated also by the radial series of dikes which cut the rim. They evidently originated in the pressure of the column of molten material in the chimney of a volcanic peak rising some distance at least above the rim.

The most convincing evidence of the existence of Mt. Mazama on the site of Crater Lake is to be found in the glaciation and drainage of the rim. The radiating glaciers, which in their descent scored the crest of the rim, could have come only from a central peak. The records of the ice and water drainage from the peak in the topography of the rim are unmistakable.

There can be no reasonable doubt as to the former existence of Mt. Mazama, but its shape and size are more difficult to determine. Mt. Mazama is composed largely of lavas similar to those of Mt. Shasta, and from the slopes of that famous peak we may draw an inference as to those of Mt. Mazama. Mt. Shasta, unlike Mt. Mazama, does not stand on an elevated platform. It rises with a majestic sweep of 11,000 feet from gentle slopes about its base, gradually growing steeper upwards to the bold peak. At the height of 8,000 feet it has about the same diameter as Mt. Mazama at an equal elevation in the rim of Crater Lake. Above this Mt. Shasta rises over 6,300 feet. The prominence of Mt. Mazama as a drainage center is quite equal to that of Mt. Shasta, but its slopes on the rim of Crater Lake, ranging from 10 to 15 degrees, are scarcely as great as those of Mt. Shasta at a corresponding elevation. On the other hand, the canyons of Sun and Sand creeks on Mt. Mazama are more profound and have been much more deeply glaciated than any of those on Mt. Shasta. It therefore appears reasonable to suppose that Mt. Mazama had an altitude at least as great and possibly greater than that of Mt. Shasta (14,380).

DEVELOPMENT OF MT. MAZAMA.

Mt. Scott is only a large adnate cone to Mt. Mazama. It belongs to the same center and holds essentially the same relation to it as Shastina does to Shasta. The slopes of Mt. Mazama reach to the plains at its eastern base, and it is one of the largest members in the composition of that range.

The beginnings of Mt. Mazama are now deeply buried beneath the lavas of the range, including those displayed on the lower slopes of the great caldera beneath the water of Crater Lake. The earliest lavas now visible are those of the southern and western lake border, and when they were erupted the volcano was normally active, sending out with its streams of lava large contributions of fragmental material to make the heavy conglomerates of the older portion of the rim. The many succeeding flows of andesite and layers of conglomerate built up the mountain slope to the crest of the rim upon the southern and western side, and Mt. Scott, too, had attained its full development when the principal vents of basalt opened and by a series of eruptions built up the surrounding country with adnate cones upon the outer slope of the rim of the lake. Then followed the large eruptions of dacite forming Llao Rock and the northern crest of the rim to Cloud Cap. These flows occurred during the period of glaciation of Mt. Mazama, and streams of lava alternated with streams of ice, a combination which doubtless gave rise to extensive floods upon the slopes filling the valleys below with volcanic débris from the mountain. In connection with the eruption of these viscous lavas (dacites) there were great explosive eruptions of pumice, spreading it for 20 miles or more across the adjacent country. The explosive activity of Mt. Mazama culminated in the eruption of the peculiar dark pumice rich in hornblende which followed the outflow of the tuffaceous dacite.

DESTRUCTION OF MT. MAZAMA—ORIGIN OF THE CALDERA.

Then came the revolution which removed the upper 6,000 feet of Mt. Mazama, as well as a large core from its base, and gave rise to the caldera. How was this change produced?

There are only two ways in which it could have been effected: either by an explosion which blew it away, or a subsidence which engulfed it.

The occurrence of vast quantities of pumice spread for a distance of 20 miles in all directions about the base of Mt. Mazama is evidence of a most tremendous explosive eruption at that point, an eruption the equal of which, so far as known, has not yet been found anywhere else in the Cascade Range. Vast quantities of fine material were blown out at the same time and by drainage gathered into the surrounding valleys, which it fills to an extent unknown, as far as I have observed, upon the slopes of any of the other great volcanoes of the range.* This impressive evidence shows conclusively that a late, if not the final, eruption of Mt. Mazama was explosive, and of such magnitude as to suggest that the removal of the mountain and the origin of the caldera may be counted among its effects. This suggestion, however, is not supported by the evidence resulting from a study of the ejected material and its relation to the lava flows of the rim. The fine material filling the valleys and the pumice throughout its great area is hornblendic in character and belongs to the dacites of the rim. Andesitic material may be present locally, but its occurrence is exceptional. Practically the whole of the material ejected by the final explosion is dacite. The eruption therefore was of the usual type and not of the kind which removes mountains. As far as may be judged from the pumice deposits in the rim, the greatest eruption of that sort of material from Mt. Mazama occurred before the extrusion of the dacite of Llao Rock, and furnishes evidence that the greatest explosion occurred long before the destruction of Mt. Mazama.

There is another matter of importance bearing directly upon the explosive theory of the caldera which renders that theory wholly untenable and fully corroborates the conclusion derived from a study of the character and distribution of the pumice. The lava exposed upon the inner slope of the rim is chiefly andesite, and its relation is such as to indicate that solid sheets of andesitic lava formed by far the larger part of Mt. Mazama. If the caldera resulted from an explosion this mass of andesitic flows would be broken to frag-

* As far as my own observation goes, the above remarks apply to Lassen Peak, Mt. Shasta, Mt. Pit, Mt. Thielsen, Diamond Peak and Mt. Hood.

ments and blown out to fall around the caldera and form a rim of fragmental material. From the size of the lake and the remaining portion of Mt. Mazama it is possible to compute approximately what the size of the rim formed in this way would be. But before we can do this it is necessary to consider the size and shape of the caldera, especially that part which lies beneath the lake.

THE BOTTOM OF CRATER LAKE.

To determine the configuration of the bottom of Crater Lake a large number (168) of soundings were made under the direction of Major Dutton. His results were published by the U. S. Geological Survey upon a special map of the lake, scale 1: 62,500 with a contour interval of 100 feet. The principal lines of soundings are noted, including 96 of the 168 measured depths. From these data, together with information from Mr. W. G. Steel, who was present when the soundings were made, the bottom has been roughly contoured upon the large scale map with a vertical interval of 500 feet. The positions of the two sublacustrine cones were indicated, and it is clear from the soundings that a large mass of lava spread from the Wizard Island vent over the lake floor. The great deep toward the eastern margin of the lake may not have been filled up any after the caldera was formed, but it is evident that the depth of the western portion has been greatly reduced by the material erupted from the three small vents upon its floor. It appears well within the bound of reason to assume that 1,500 feet is not greater than the average depth of the original caldera below the present level of the lake.

ESTIMATED SIZE OF FRAGMENTAL RIM.

The area of the caldera, as marked out by the crest of the rim, is over 27 square miles, and its original volume, making some allowance for the subsequent refilling from the craters on its floor, is about 12 cubic miles. If to this we add 5 cubic miles for the part of the mountain above the caldera, and this is a conservative estimate, we get 17 cubic miles of material for whose disappearance we have to account. If this material were blown out by a great explosion and fell equally distributed upon the outer slope of the rim, within three miles of the crest it would make a layer over 1,000 feet in thickness. This mass would be so conspicuous and composed of such fragmental material that its presence could not be a matter of doubt. There can be no question concerning its complete absence, for the surface of the outer slope of the rim exposes everywhere either glaciated rock, glacial moraine or pumice, all of which are features which belonged to Mt. Mazama before its destruction, and no trace of a fragmental rim, such as is referred to above, was found anywhere.

The evidence of the outer slope of the rim lends no support to the view that Mt. Mazama was blown away and the caldera produced by a great volcanic explosion. In fact, it completely negatives such a view, and we are practically driven to the opinion that Mt. Mazama has been engulfed. Major Dutton, who studied the rim of Crater Lake with a training gained from among the active volcanoes of the Hawaiian Islands, recognized the wide distribution of the pumice, but the absence of a well-defined fragmental rim kept him from attributing the origin of the caldera to an explosion. On the other hand, he fully appreciated the difficulty of proving that it originated in a subsidence.*

The present inner slope of the rim may not in all cases, or even generally, be the one formed at the time of the collapse. In some cases, however, the inner slope was

* U. S. Geological Survey, 8th Ann. Rept., Part I., p. 157.

formed at that time. Of this we have evidence in the behavior of the flow at Rugged Crest. It was one of the final flows from the slope of Mt. Mazama. Before the central portion of the flow where thickest had congealed within the solid crust, Mt. Mazama sank away and the yet viscous lava of the middle portion of the stream flowed down over the inner slope of the andesitic rim into the caldera. The liquid interior of the flow having withdrawn, the crust caved in and formed Rugged Crest with its peculiar chaotic valley of tumbled fragments, columns and bluffs. Other explanations of the peculiar reversed flow of Rugged Crest have been sought, but without avail. The facts are so simple and so direct that they appear to preclude any other hypothesis.

It would be apparent from the facts also that the collapse of the mountain was at least moderately sudden, for it is not at all probable that the Rugged Crest flow was long exposed before reaching the present level of the lake and beyond into the caldera.

We may be aided in understanding the origin of the caldera by picturing the condition that must have obtained during the eruption of the Rugged Crest dacite from the upper slope of Mt. Mazama. At that time a column of molten material rose in the interior of the mountain until it overflowed at the summit or burst open the sides of the mountain and escaped through the fissure. The rent of the mountain side is formed in such cases by the pressure of the column of molten material it encloses. The molten lavas being heavy, the pressure of the column within the mountain is very great, and increases rapidly with the height of the volcano. During the final activity of Mt. Mazama there must have been within it a column of lava over 8,000 feet in height above the base of the Cascade Range. It is possible that on account of this great pressure, aided possibly by some other forces, an opening was formed low down upon the mountain slope, allowing the lava to escape. The subsidence of the lava within the mountain left it unsupported and caused its collapse. Phenomena of this sort are well known in connection with the Hawaiian volcanoes. In 1840, according to Professor J. D. Dana, there was an eruption from the slopes of Kilauea, 27 miles distant and over 3,000 feet below the level of its summit. At Kilauea the summit of the lava column is well exposed in a lava lake. In connection with the eruption of 1840 the lava of the lake subsided to a depth of 385 feet, and the irregular walls surrounding it left without support broke off and fell into the molten material below. During the intervals between the eruptions of Kilauea the molten column rises towards the surface only to be lowered by subsequent eruptions. The subsidences, however, are not always accompanied by an outflow of lava upon the surface. At other times it may gush forth as a great fountain hundreds of feet or more in height, as if due directly to hydrostatic pressure.

That Mt. Mazama disappeared and the caldera originated through subsidence seems evident, but the corresponding effusion upon the surface, if such ever occurred, has not yet been found. It is hardly conceivable that 17 cubic miles of material, much of it solid lava, could collapse, be refused and sink away into the earth without a correlative effusion at some other point.

The bottom of the caldera is over 200 feet below the level of Klamath Marsh, which lies at the eastern base of the Cascade Range, and it is not to be expected that the point of escape would occur at any level above (4,200). This consideration would indicate that the effused mass should be sought on the western slope of the range. The 4,200-foot contour, the level of the lowest portion of the lake bottom, occurs along Rogue River at a distance of less than 12 miles from the rim of the lake. The correlative lavas might perhaps be expected to be dacites closely related to the final flow of Mt. Mazama, but on Rogue River no such lavas were seen,—they are generally basalt; nor is there any suggestion of the escape of such an enormous mass of lava as recently as the time of the great collapse. Whether or not we are able to discover the corresponding effusion, there seems no reasonable doubt that Mt. Mazama was once a reality and that it was wrecked by engulfment.

J. S. DILLER.

U. S. GEOLOGICAL SURVEY.

*THE TEACHING OF ANTHROPOLOGY IN THE UNITED STATES.**

THERE is a feeling among students of anthropology that official instruction in that field has not kept pace with the growth of societies and museums of anthropology, as well as with the ever-increasing volume of literature pertaining to the subject. A science which is rapidly filling our museums and now occupies so much space in current publications should have an exponent at every important seat of learning.

The past decade has, however, witnessed such rapid strides in the progress of anthropological teaching that fears for the future of this particular field of activity may, after all, prove groundless.

Nearly three years ago I began to collect information on the extent of instruction in anthropology in Europe and the United States. The results were embodied in a paper† that was read before Section H at the Columbus meeting, August, 1899, and which led to the appointing of a committee to consider ways and means of furthering instruction in anthropology in our own institutions of learning. The members of the original committee appointed by Vice-President Wilson were W J McGee, of Washington, chairman; Frank Russell, of Cambridge; and George Grant MacCurdy, of New Haven. Two additional members, Franz Boas, of New York, and W. H. Holmes, of Washington, were appointed later and, at the New York meeting in 1900, the committee of five was made a special committee of the Association, 'Committee on the teaching of anthropology in America.'

This committee is at present preparing a circular, the object of which is to set forth the aims, scope and importance of anthropology, as well as its place in higher education. At a recent committee meeting held in Washington it was decided that such a circular note, to be of the highest value, should be based on the latest and fullest information relative to the extent and trend of instruction in anthropology. Having already published one paper on the subject, I was appointed to bring that paper up to date so far as it related to the United States.

A circular note of inquiry was addressed to one hundred and twenty-one of our most important universities, colleges and medical schools. The number and character of the responses have been very gratifying. Of the one hundred and twenty-one institutions 31* offer instruction in anthropology, 36 do not, and 54 have not yet been heard from.

This is a vast improvement over the conditions which prevailed in 1899, so far as we had knowledge of them, as may be seen by comparison with the following table prepared two years ago:

* Read at Denver before Section H of the American Association for the Advancement of Science, August 29, 1901.

† SCIENCE, December 22, 1899, pp. 910–917.

* Including Phillips Academy, Andover, Mass.

Countries.	Institutions.	Professors.	Assistant Professors.	Instructors, etc.	Total Teaching Force.	Faculties.
British Isles	4	1	0	8	9	Natural Science.
Germany	14	1	2	15	18	Philosophical.
France	4	11	0	1	12	Philosophical or Faculté des Lettres.
Italy	6	3	0	5	8	Philosophical; Nat. Sci.; Med.
Spain	1	1	0	0	1	Science.
Portugal	1	1	0	0	1	Philosophical.
Switzerland	2	0	1	1	1	Natural Science.
Austria-Hungary	3	2	1	1	4	Philosophical.
Russia	3	1	0	3	3	Natural Science.
Holland	3	0	0	3	3	Various.
Belgium	2	1	0	1	2	Medical.
Scandinavia	1	0	0	2	2	Philosophical.
United States	11	1	1	15	17	Various.
	55	23	5	55	81	

The details furnished by officers of their respective institutions are as follows:

BELOIT COLLEGE, BELOIT, WISCONSIN.

"A slight reference is made to anthropology in a one-hour course in American archæology throughout the sophomore year." This is elective and is offered by Dr. G. L. Collie, Professor of Biology and Curator of the Rust Museum.

BELLEVUE COLLEGE, BELLEVUE, NEBRASKA.

Anthropology is grouped with the history of civilization and sociology. Professor C. A. Mitchell gives a general sketch of anthropology in a three-hour course for one semester.

BOSTON UNIVERSITY, BOSTON, MASSACHUSETTS.

According to President Warren, while anthropology, in its newest developments and literature, receives incidental attention in a number of courses, no distinct course or courses are devoted to the subject exclusively.

BROWN UNIVERSITY, PROVIDENCE, RHODE ISLAND.

Anthropology is classed with zoology and geology and is taken as a senior elective. Professor A. S. Packard's general course includes the principles of ethnology, ethnography and prehistoric archæology.

The Museum of Anthropology in Rhode Island Hall contains a collection of 'articles of dress and rare implements from foreign countries, and valuable stone implements of the aboriginal races of America.'

CLARK UNIVERSITY, WORCESTER, MASSACHUSETTS.

Anthropology is grouped with psychology and may be taken as major or minor for the Ph.D. degree.

Alexander F. Chamberlain, Ph.D., Acting Assistant Professor of Anthropology, offers two courses, twice a week throughout the year, besides theses, conferences and laboratory work. The general course embraces history, scope and relations of the science of anthropology, physical anthropology, ethnography, linguistics, criminal and pathological anthropology, historical and archæological. The special course is upon anthropological topics most akin to psychology and pedagogy.

During the month of July, Professor Chamberlain gave a course of twelve lectures on 'Education among Primitive Peoples' at the Summer School of Clark University.

COLLEGE OF PHYSICIANS AND SURGEONS, BOSTON, MASS.

Dr. John S. Flagg, Professor of Biology and Embryology and Lecturer on Anthropology, gives a series of 'optionally attended lectures, both general and special, on anthropology.' Besides, 'all matters of biology and embryology are treated from a more or less anthropological standpoint.'

COLUMBIA UNIVERSITY, NEW YORK CITY.

Anthropology is included in the Division of Philosophy and Psychology.

Franz Boas, Ph.D., Professor of Anthropology.

1. Ethnography. Lectures, essays and discussions.
2. Statistical study of variation, introductory course.
3. Physical anthropology. Lectures and laboratory work.
4. American languages.
5. Physical anthropology, ethnology, North American languages. Research work in conjunction with Professor Farrand.

Livingston Farrand, Ph.D., Adjunct Professor of Psychology.

1. Anthropology, general introductory course. Lectures, essays and discussions.
2. Ethnology—primitive culture.

COLUMBIAN UNIVERSITY, WASHINGTON, D. C.

There is a department of anthropology in the Corcoran Scientific School where students may choose the subject either as major or as minor for the degree of Ph.D. Professor Otis T. Mason, LL.D., of the U. S. National Museum, is the Director and offers the following courses:

1. Study of the races of man.
2. History of culture as embodied in the languages, industries, art, social life, philosophy and mythology of the various peoples of the earth.
3. Archæology and folk-lore.

Other professors whose courses bear more or less directly on anthropology are Daniel K. Shute, M.D., Anatomy; William P. Carr, M.D., Physiology; Mitchell Carroll, Ph.D., Classical Archæology; Andrew F. Craven, Ph.D., Sociology; Theodore N. Gill, LL.D., Zoology; Edward B. Pollard, Ph.D., Semitic studies; J. McBride Sterritt, D.D., Political Economy.

CREIGHTON UNIVERSITY, OMAHA, NEBRASKA.

Anthropology is studied as a division of mental philosophy and 'considered as a branch of primary importance.' Seniors devote one hour a week to the subject, which is in charge of C. Coppens, S. J., Professor of Philosophy.

DARTMOUTH COLLEGE, HANOVER, NEW HAMPSHIRE.

David Collin Wells, Professor of Sociology.

1. Anthropology and ethnology, introductory course, 54 exercises.
2. Anthropological geography. Man in relation to his physical environment, as determining his dispersal over the face of the earth, his mode of life, and the density of population. Fifty-four exercises.
3. Social statistics and applied sociology. The biological side of social life. Fifty-four exercises.

GEORGETOWN UNIVERSITY, WASHINGTON, D. C.

Anthropology is officially classed with psychology and is treated in the senior year and in the Graduate School. The Rev. Edward I. Devitt, S.J., Professor of Psychology, and the Rev. Timothy O'Leary, S.J., Professor of Philosophy, have charge of the work.

HARVARD UNIVERSITY, CAMBRIDGE, MASS.

Division of American Archæology and Ethnology, Courses in Anthropology.

Frederick W. Putnam, A.M., S.D., Professor and Curator of the Peabody Museum of American Archæology and Ethnology.

1. Special course in American archæology and ethnology. Museum, laboratory and field work. Theses.

Frank Russell, Ph.D., Instructor in Anthropology.

1. General anthropology. Lectures and theses.

2. Somatology. Lectures and laboratory work.
3. American archæology and ethnology.
4. Advanced somatology. Laboratory work and theses.

James H. Woods, Ph.D., Instructor in Anthropology.

1. Primitive religions. Lectures, reading and reports.

NATIONAL UNIVERSITY, WASHINGTON, D. C.

Thomas Wilson, LL.D., of the U. S. National Museum. Professor of Prehistoric Anthropology.

NEW YORK UNIVERSITY, NEW YORK CITY.

J. J. Stevenson, Professor of Geology, offers a course in anthropology, one hour a week throughout the year. The course 'covers the natural history of man, deals very little with ethnology and not at all with sociology.'

NIAGARA UNIVERSITY, NIAGARA COUNTY, N. Y.

Anthropology is treated as a branch of philosophy. The philosophy course extends over two years, of which time anthropology occupies about one sixth, or sixty hours. The Rev. P. J. Conroy is the instructor.

PHILLIPS ACADEMY, ANDOVER, MASS.

A Department of Archæology was recently established with a fund of $150,000 A museum is to be erected immediately. Dr. Charles Peabody, of Harvard, is honorary director and Mr. Warren K. Moorehead is curator. There are about 40,000 specimens with which to begin study. Dr. Peabody and Mr. Moorehead will give instruction after September, 1901.

OHIO STATE UNIVERSITY, COLUMBUS.

Mr. W. C. Mills, Curator, Ohio State Archæological and Historical Society, gives an approved course in anthropology which is open to all members of the University. More than 100 students have taken the course within the past two years.

UNIVERSITY OF CALIFORNIA, BERKELEY.

Professor W. E. Ritter, of the Department of Zoology, is preparing to give instruction in anthropology.

UNIVERSITY OF CHICAGO, CHICAGO, ILL.

Department of Sociology and Anthropology.

Frederick Starr, Ph.D., Associate Professor of Anthropology and Curator of the Anthropological Section of Walker Museum.

(*a*) Six courses for seniors, covering general anthropology, ethnology, prehistoric archæology and physical anthropology.
(*b*) Courses for graduates.
1. Mexico. Archæology, ethnology, physical anthropology.
2. New Mexico. Pueblo Indians.
3. Japan.
4. Laboratory courses in anthropology.

During summer quarters, two of the above courses are offered; in others, two courses in class work and laboratory work besides.

Merton L. Miller, Ph.D., Associate in Anthropology.

1. The races of Europe. Seniors.

William I. Thomas, Ph.D., Associate Professor of Sociology, gives a number of courses related to anthropology.

UNIVERSITY OF ILLINOIS, URBANA.

Dr. A. H. Daniels, Professor of Philosophy, gives a course in general anthropology, three hours per week for one semester.

Physical and psychical elements of ethnography. Origin of man. Races of mankind. Historical and comparative study of customs, ceremonies, rights beliefs and folk-lore of primitive peoples.

UNIVERSITY OF INDIANA, BLOOMINGTON.

Anthropology is officially classed with the Department of Economics and Social Science.

Ulysses Grant Weatherly, Professor of Economics and Social Science, offers two terms' work, two hours per week. Physical anthropology, anthropometric work, race classification, etc. The origins of civilization and of society, with some study of American antiquities.

UNIVERSITY OF KANSAS, LAWRENCE.

Frank W. Blackmar, Professor of Sociology.

1. General anthropology, twenty weeks, five hours a week.

2. General ethnology, twenty weeks, five hours a week.

UNIVERSITY OF MINNESOTA, MINNEAPOLIS.

Samuel G. Smith, Lecturer in Sociology, treats incidentally of anthropology in his courses.

UNIVERSITY OF MISSOURI, COLUMBIA.

Charles A. Ellwood, Professor of Sociology.

One course in ethnology, three hours a week, throughout the year.

There is no course given in anthropology in the narrow sense of the term. The work in ethnology 'necessarily covers the subject matter of anthropology in a general way.' The work now offered is only elementary. Professor Ellwood will offer advanced work as soon as an assistant in anthropology and ethnology is appointed.

UNIVERSITY OF NEBRASKA, LINCOLN.

The reply of Professor Charles E. Bessey, Dean of the University, is quoted in full:

"As a separate subject it has no place as yet in the departments of instruction. Indeed, the word, 'Anthropology' does not occur in our Annual Calendar. Yet we have for years offered instruction in some of the topics which enter into scientific anthropology. Thus we have several courses covering the greater part of the field of somatology (in the department of zoology), and psychology (in the department of philosophy), as well as something of anthropology proper (in the departments of sociology and history). If these were to be brought together in one greater department the amount of anthropological work offered and actually taken by students each year would be found to be quite considerable. I estimate that during the year just closed fully 1,200 of the 2,200 students in the University pursued anthropological studies. If we were to bring these together they would make a department second only to that of English, which has about 1,800 students."

The instructors are Drs. H. B. Ward (Zoology); R. H. Wolcott (Physiology); Dr. A. B. Hill (Psychology, Logic, Ethics); Dr. E. A. Ross (Sociology); and Dr. F. M. Fling and Professor H. W. Caldwell (History).

UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA.

Faculty of Philosophy. Courses in ethnology and American archæology.

Stewart Culin, Lecturer and Curator of the Section of Asia and General Ethnology.

1. Outlines of North American archæology.

2. Comparative ethnology.

In order to systematize the work offered in archæology, Dr. Hilprecht, Professor of Semitic Philology and Archæology; Dr. Clay, Lecturer in Assyrian, Hebrew, and Semitic Archæology; and Dr. Bates, Lecturer in Greek and Classical Archæology have been associated with Mr. Culin in the administrative group entitled Archæology and Ethnology. The work is to be developed in connection with the Free Museum of Science and Art.

Progress is reported in the movement to found a 'Brinton Memorial Chair' of Anthropology at the University of Pennsylvania.

UNIVERSITY OF VERMONT, BURLINGTON.

Anthropology is grouped with natural and social science.

G. H. Perkins, Professor of Geology.

1. General course. Senior elective. A survey of the ethnological, social, moral and intellectual characteristics of the principal races of the world, followed by a discussion of the origin and development of laws, government, arts, industries, language, literature and religious systems.

Professor Emerson.

1. Social institutions.

UNIVERSITY OF WISCONSIN, MADISON.

Joseph Jastrow, Ph.D., Professor of Psychology, offers one course bearing on anthropology. It is entitled, 'Mental Evolution' and is based on Tylor's Anthropology.

WESTERN RESERVE UNIVERSITY, CLEVELAND, OHIO.

M. M. Curtis, Professor of Philosophy, gives a course of lectures on the history of anthropology, its main problems and bearings.

WILLAMETTE UNIVERSITY, SALEM, OREGON.

President Willis C. Hawley, Professor of Sociology, offers a course in anthropology for juniors and seniors consisting of text, lectures and assigned readings. Two hours a week for the year.

YALE UNIVERSITY, NEW HAVEN, CONN.

William G. Sumner, LL.D., Professor of Political and Social Science.

What Professor Sumner offers is described by himself as follows: "Somatic anthropology has no independent place in the undergraduate curriculum. It is taught as an adjunct to the social sciences by text-books and lectures. Two hours per week. Special students in the Graduate School have lessons in the subject as presented in Ranke's 'Der Mensch,' with lectures, other literature and museum illustrations." The last named course has hitherto been given on alternate years.

E. Hershey Sneath, Ph.D., Professor of Philosophy.

1. Philosophical anthropology. An outline study of man, his body and mind in their relations, his relations to nature, to his fellows, and to God.

Of the thirty-one universities and colleges offering anthropology, it is found to be an adjunct of sociology in nine, of philosophy in five, of psychology in three, of geology and zoology in five, and of medicine in one; while in five instances it stands practically alone and in three it is unclassified.

The process of differentiation has already taken place in the larger institutions and is destined to reach all at an early date. If about four fifths of those who are teaching the subject are impelled to do so because of its important bearing on their chosen field of work and because there is, at present, no one else to do it, they have a right to depend on being relieved of this additional burden by their own students, some of whom will specialize in anthropology and hold professorships where none now exists.

This seems to be the normal line of development and would of itself, in time, suffice to carry instruction in anthropology to every growing college and university in America. But there is evidence of forces at work which will serve to accelerate the general forward movement. An instance of this is the founding of a 'Department of Archæology' at Phillips Academy, Andover, Massachusetts, with two instructors, a collection of 40,000 specimens and funds to carry on the work.

No institution of higher learning, worthy of the name, can long afford to be without advantages which can be had at a first class preparatory school.

George Grant MacCurdy.

New Haven, Conn.

ON THE MEASUREMENT OF TIME.

In the period of the earth's rotation on its axis, called the sidereal day, Nature has provided a convenient, easily determined and, for present purposes, practically invariable unit of time. For the subdivision of the day into the arbitrary units of time called hours, minutes and seconds, recourse is had to artificial mechanical devices known as clocks.

It may perhaps be stated in general, without serious danger of dispute, that the pendulum clock is the most accurate and reliable of all types of timekeeping mechanism. Chronometers have the advantage of portability and often run remarkably well for considerable periods of time, but they cannot compete with the pendulum clock in carrying an even rate during a series of months or years.

Yet a still higher degree of accuracy than that now prevalent in the performance of astronomical clocks is attainable, and is necessary in the present state of astronomy. There seems to be no reason why improvements in timekeeping should not take place along with the general progress in other directions, where scientific results depend on the perfection of mechanical appliances. The sidereal clock is one of the main features of an astronomical observatory, and if it is to continue to be used to measure the angular distance in right ascension between the fixed stars, greater uniformity in its rate than is now usual must be secured. It is also important in time service work to have clocks which will carry time with greater accuracy during long intervals of cloudy weather when observations of the stars cannot be made. The development of the pendulum clock dates from the time of Huyghens, the celebrated Dutch astronomer, who, in 1656, published his theory of the pendulum. From that time until the present the perfecting of the pendulum clock has received the attention of the best mechanical artists in Europe and America. Important improvements in clock-making were made early in the eighteenth century, when the mercurial compensation and dead-beat escapement were invented by Graham, of England. The gridiron pendulum, previously suggested by Graham, was soon after constructed by an Englishman named Harrison.

Excellent practical work was done a century later by a German named Kessels, of Altona, who improved the dead-beat escapement by modifying the form of the 'anchor.' The mechanical work of Kessels is remarkably fine. He made a clock for the observatory at Pulcowa in Russia, and another for the celebrated astronomer, Bessel at Königsberg. Bessel investigated the running of the clock with his usual thoroughness and was much pleased with it. He writes of Kessels as 'der kenntnissreiche und vorsichtige Kunstler.' Kessels also made a clock for the Naval Observatory in Washington, which, after running for half a century, is in perfect condition and is still giving good service.

Later Tiede, of Berlin, and Hohwü, of Amsterdam, attained great success in making astronomical clocks, and there are now two or three English and American makers who are doing work of great merit.

The Dennison gravity escapement, which has recently come into use, is supposed to be an improvement on the dead-beat escapement, because any small irregularity in the action of the train of wheels should theoretically have little or no effect on the pendulum. It should, for this reason, be better adapted for use in clocks provided with an electric contact, worked, as is usually the case, by a toothed wheel on the seconds arbor for transmitting signals for record on the chronograph. This is an important practical advantage, and to more certainly secure it, American clocks are usually made strong and heavy and are run with heavy weights. The relative merits as timekeepers of the best American and

German clocks is an interesting subject for investigation.

Within the last ten years a clock by Riefler, of Munich, having certain novel features, has come into notice. In the Riefler clock the pendulum rod is a tube filled with mercury by which the compensation is effected. The pendulum is perfectly free, except that it receives its impulse from the spring by which it is suspended. The Riefler clocks have given good results, and one of them has been adopted as the standard clock of the Pulcowa Observatory at Odessa in Russia.

Various devices have been used with success at Greenwich, Pulcowa and elsewhere for compensating clocks for variations of barometric pressure. A newly discovered alloy of 36 per cent. nickel with 64 per cent. steel, which has a remarkably small coefficient of expansion, makes it possible to compensate clocks more perfectly for changes of temperature.

The astronomical clock is a simple piece of mechanism and the perfection of design, excellence of workmanship and the efficiency of the various contrivances for compensating for variations of temperature and barometric pressure seem to have been developed to a point beyond which no great advance is to be expected along present lines. Even if the effects of change of temperature and air pressure on the pendulum could be perfectly eliminated by compensation, we should still have their effects on the clock train as well as the harmful influence of dust and moisture, unless the clock-case affords protection from the latter.

The most obvious chance for future progress seems to lie in securing the greatest possible uniformity of conditions. With a clock securely mounted, enclosed in an air-tight case and kept at an invariable temperature and barometric pressure, the only conceivable cause for variations in its rate would be perhaps the imperfections in the mechanism of the clock itself. It is necessary for obvious reasons that the sides of the air-tight case should be rigid. A constant pressure cannot be maintained without constant temperature, as may be seen from the well-known formula connecting the pressure, volume and temperature of a body of gas,

$$pv=kt,$$

in which, for our present purpose, v may be regarded as constant. We may therefore write,

$$p=k't.$$

In an air-tight case filled with air the change of pressure due to a change of temperature of 1° Centigrade is between 2 and 3 millimeters for pressures of 650 to 750 millimeters.

The first successful attempt to mount a clock in an air-tight case seems to have been made by Tiede, of Berlin, who in 1865 installed for Professor Foerster in the basement of the Berlin Observatory an electric clock in an air-tight glass cylinder. This clock, the escapement of which is a very simple piece of mechanism, is described by Professor Foerster in the 'Astronomische Nachrichten,' Nr. 1636. The impulses given to the pendulum are independent of the strength of the current, since they are produced by the falling of weights which are lifted each second by an electromagnet. The reason for adopting the electric clock was that the winding of a clock run by weights is attended by difficulties when the clock is enclosed in an air-tight case. While this clock does not run under ideal conditions, being subject to a gradual change of temperature and a consequent slight variation of barometric pressure during the year, it is probably the best time-keeper in the world. It has frequently run for periods of two or three months with such accuracy that the average deviation of the mean daily rates for the whole period is only $0^s.015$ and with a maximum deviation of $0^s.03$. The clock was dismounted for cleaning in 1894 after running continuously for eight years. The pressure of the air in the case has been kept below the normal atmospheric pressure, and mention is made of the pressure having been made at one time as low as 180 mm., about 7 inches. Little difficulty seems to have been found in keeping the cylinder air-tight. Indeed a slight progressive diminution of the pressure in the cylinder has been observed, and is attributed by Professor Foerster to oxidation of the metal parts of the clock and to absorption by the glass walls of the cylinder of particles of moisture from the air within. This clock has been for thirty-six years the normal clock of the Berlin Observatory.

Soon after, Tiede succeeded in mounting a clock run by weights in an air-tight glass cylinder, and it was exhibited at the Paris Exposition of 1867. In his report of the Pulcowa Observatory for 1867 Otto Struve, the director, announced, with enthusiasm, Tiede's success, and stated that a clock run by weights and enclosed in an air-tight case had been ordered for that observatory. It appears subsequently that much difficulty was experienced from various causes in getting the clock into working order. But it was finally set up, about the year 1880, in the basement of the Pulcowa Observatory, where the temperature changes only four or five degrees a year, and was found to run with a satisfactory rate. This was for many years, and presumably is still, used as the principal clock of that observatory, which is an institution widely known for the high quality of its work. The pendulums of these clocks at Berlin and Pulcowa were compensated, of course, for change of temperature.

The Riefler clocks mentioned above are constructed so as to be easily mounted in air-tight cylinders, which together with the clock itself rest on a shelf bolted to the clock pier. There is one of these clocks mounted in the usual way at the Georgetown University Observatory at Washington. It is run by a weight which is wound up every few minutes by electricity. But it is not found practicable, under the conditions there, to keep the temperature strictly constant.

The standard clock of the Greenwich Observatory by Dent, of London, is mounted in the basement of the observatory, where the temperature changes are small and very gradual, and is fitted with an electrical device for barometric compensation.

The standard clock of the Paris Observatory, by Winnerl, enjoys the unique distinction of being mounted in a vault at a depth of 27 meters underground. The temperature changes at that depth are of course very small, being, according to Tisserand, not more than one or two hundredths of a degree during the year, but the effect of barometric changes on the rate of the clock has been found to be serious.

There seems to be no case where an attempt has been made to keep both temperature and barometric pressure strictly constant. There is, I think, no doubt that it is entirely feasible to maintain a suitably constructed vault at a practically constant temperature throughout the year by artificial means. Then, with an air-tight case, the barometric pressure could be kept practically uniform and the clock would be completely protected from dust and moisture. Even if it were not practicable to get the case perfectly air-tight, a practically uniform pressure could be maintained by exhausting the air from time to time, provided that the leakage is very small.

Accurate comparisons of clocks running

under such uniform conditions would be exceedingly valuable, not only in giving the highest order of results in timekeeping, but also in developing the peculiarities and comparative merits of the clocks themselves. The extreme accuracy with which two clocks, one keeping sidereal and the other mean time, can be compared by coincidences of the beats, which take place every six minutes, is familiar to every astronomer. Again, the more rapid minor variations in the rates of clocks could perhaps be detected and their periodicity determined by comparison with the vibrations of a pendulum swinging in vacuo.

Improvement in performance of astronomical clocks is of special importance in fundamental astronomy. An independent redetermination of the positions of the fundamental stars is necessary, and for this the most accurate possible timekeeping is needed because, in order to be of value in the present state of astronomy, such work must be of the highest degree of accuracy. All this has long been recognized by astronomers, and during the past forty years efforts in the direction of improved timekeeping have been made in all the principal observatories of Europe where fundamental work is attempted.

Commenting on the bad effect of variations in the rates of astronomical clocks due to the diurnal changes of temperature, Professor Foerster, the distinguished astronomer, who has been for 38 years director of the Royal Observatory at Berlin, wrote in 1867:

"How detrimental to accuracy such a large and changeable irregularity is, is evident since it operates like a variable division error.

"It is therefore necessary, in order that a clock may be of service in absolute determinations of star places, to have it protected from the daily temperature change, and also from all sudden changes of temperature. That is, it should be mounted in a place of nearly constant daily temperature so that it will remain for the compensation of the pendulum to effect only the last remaining fine adjustment.

"The air-tight confinement is safe in underground rooms or in heavy masonry against injury to the clock-work, because in the hermetically enclosed space any moisture present can be done away with by known means and the coming in of new moisture is impossible."

MILTON UPDEGRAFF.
U. S. NAVAL OBSERVATORY,
WASHINGTON, D. C.

SCIENTIFIC BOOKS.

The Stars, A Study of the Universe. By SIMON NEWCOMB. Pp. v + 333. New York, G. P. Putnam's Sons; London, John Murray.

This is professedly a book written to order, as a part of the science series now appearing under the editorial supervision of Professor Cattell, and its author states plainly in his preface that he has found the task, 'to sketch in simple language for the lay as well as the scientific reader the wonderful advances of our generation in the knowledge of the fixed stars,' much more onerous than he had anticipated, on account of 'the extent and complexity of the subject and the impossibility of entering far into technical details in a work designed mainly for the general use.'

If one may judge the extent of systematized knowledge concerning the fixed stars by the space allotted to its presentation in the most approved text-books of general astronomy, from that of Arago to the present time, it appears that this branch of astronomy has grown during the century from about one eighth to one sixth part of the entire science. But the indexes to recent volumes of the principal astronomical periodicals show that about one-third of the articles there appearing relate to problems of stellar astronomy and thus mark an accelerated growth of interest in and knowledge of the remoter parts of the visible universe. The author who attempts to digest this rapidly accumulating material and to present its substance in untechnical form merits the thanks of both professional and lay readers, even though occasional inaccuracies or omissions affect the text or the rapid advance of knowledge renders obsolete some passages before the ink is dry upon the pages. A double acknowledgment is due when, as in the present case, that author is the one astronomer marked out by long and distinguished service in important parts of this field as peculiarly adapted to the task. The title, Retired Professor U. S. Navy, that follows the author's name upon the title page, suggests thoughts far from complimentary to that fatuous governmental policy in accordance with which astronomers are retired from the public service upon reaching an age limit not far removed from the maximum of intellectual power.

In substance, though not in formal arrangement, the present work falls naturally into two parts; first, a description of methods of research and such elementary classification of stars as are the familiar province of the better text-books, *e. g.*, the grouping of stars into constellations, the explanation of stellar magnitudes, proper motions, parallaxes, stellar spectroscopy, the description of the phenomena presented by variable and double stars, nebulæ, etc.; and second, a more original part devoted to the larger problems of stellar distribution, the significance of the milky way, the sun's motion, stellar evolution and similar matters which may be grouped, fairly enough, under the title, the structure of the heavens. We welcome here a presentation of some of Kapteyn's results not hitherto accessible, of Huggins's views of stellar evolution, and the author's own methods, inferences and conclusions from the new material collected and sifted in the preparation of this work. As types of these last-named categories it is interesting to note the simple statistical method (p. 300) by which certain results first obtained by Kapteyn through an elaborate and tedious mathematical process are independently derived. Of a very different order is the suggestion made with reference to Bailey's discovery of variable stars in clusters, that there is 'a strong presumption that the variations in the light of these stars are in some way connected with the revolution of bodies round them, or of one star round another.' The distribution of the stars in space is treated with a fullness of detail that occasions some surprise at the almost complete neglect of a possible absorption of starlight in the interstellar spaces; a possible defect of transparency in the celestial void, that has been rendered a classic theme by Struve's speculations and more recently has been elaborated by Schiaparelli.

Taken as a whole the work contains in excellent form a large amount of material interesting to the professional astronomer and in even larger measure valuable to the popular expositor of astronomy, teacher, lecturer or writer. As it is sure to be largely drawn upon by this class it seems important to eliminate as rapidly as possible those errors and inaccuracies inseparable from a first edition, among which we note the following:

P. 158, line 10, for eleven read five and one-half.

P. 182, line 3, for Triphid read Trifid.

P. 194, insert a^3 in the numerator of the fraction.

P. 198, line 1, for $2m$ read 2^m.

The statement made on p. 179 with regard to the Orion nebula, 'This is plainly visible to the naked eye and can be seen without difficulty whenever the constellation is visible,' does not at all correspond to the experience of the present writer who has great difficulty in seeing the nebula with unaided vision, even under favorable circumstances, and whose experience is shared by a dozen young people, of both sexes, who at his request have looked for the nebula.

In the matter of nomenclature some objection may fairly be raised to the apparently needless introduction of new terms in place of the familiar old ones, such as the logically inappropriate, apocenter, pericenter, for apastron, periastron, in connection with double star orbits, and the rechristening of the Fraunhofer lines of the solar spectrum as Wollaston lines. But with all due allowance for such minor blemishes the book remains in its entirety a notable contribution to the literature of astronomy. Its style is clear and attractive and the illustrations, some excellent, are in the main adequate although many of the diagrams are disagreeably crude. A familiar literary device, that of prefixing a brief metrical introduction to each chapter, has here been so felicitously applied as to deserve especial mention. An excellent table of contents and index greatly facilitate the use of the work as a book of reference. GEORGE C. COMSTOCK.

EARTH-CURRENT OBSERVATIONS IN THE GERMAN TELEGRAPH SYSTEM.*

The origin of these important observations dates back to 1881, when a committee was called together by Werner Siemens, to study the phenomena of earth-currents. Through their efforts, two underground cables were provided by the Imperial Telegraph System, one running in an easterly direction from Berlin to Thorn, 262 km., the other nearly due south from Berlin to Dresden, 120 km. The present work deals chiefly with the continuous observations of earth-currents from these two lines, from 1884 to 1888. The Prussian Academy of Sciences assisted, in part, in the maintenance of the observations.

The assumption is made at the start that the observed currents are due to potential differences between the ends of the lines; that is, they are derived from currents that flow in closed circuits within the earth, parallel to its surface. Of course *vertical* differences of potential have to be left out of consideration.

The attempt to express the intensities in the two lines by trigonometrical formulæ according to Gauss, using the latitude and longitude as variables, leads to equations whose constants are too difficult to be determined. Assuming the validity of Ohm's law, however, the intensity of the earth-current components in the two directions may be given by the equations

$$J = A\frac{W}{L}i, \quad J' = A\frac{W'}{L'}i',$$

where A is a constant and W, W' are the resistances, L, L' the lengths and i, i' the observed current strengths in the two lines respectively.

We thus obtain for the total earth-current,

$$E = A\sqrt{\frac{W^2}{L^2}i^2 + \frac{W'^2}{L'^2}i'^2}.$$

The value of the constants was computed for each of the two lines. The results are only relative, however, as no reductions to absolute units were made.

The most characteristic feature of earth-current variations is their dependence upon the position and condition of the Sun. The diurnal and annual variations are especially marked. In view of this, the attempt is made to modify the trigonometrical representation in such a way as to use, instead of the latitude, the angle with the Sun's declination, and for the longitude, the local time or the right ascension of the Sun. The results indicate, however, as was to be expected, that this is not sufficient, but that other factors have to be considered. In general there can be distinguished a constant component of the current, due to terrestrial and local conditions, and a variable component, depending chiefly upon the Sun. The four years of observations were not enough to make the derivation of accurate formulæ possible. As approximations, however, expressions for the components in the two directions were derived, as functions of the local time and its multiples, from which the diurnal variation is made evident.

The self-recording instruments were of two different types. In the Berlin-Dresden line a Siemens 'Russschreiber' was used, in the other line a mirror-galvanometer reflected a beam of light on to photographic paper. The sensitiveness of both instruments was frequently determined, and though the results were not reduced to absolute measure, still it is always possible to get accurate relative values between the two lines.

The magnetic records, which, as the title indicates, formed an essential part of the work, were obtained chiefly from the observatories at Wilhelmshaven and Vienna, but to a lesser extent also from the observations during the

* Die Erdströme im deutschen Reichstelegraphengebiet und ihr Zusammenhang mit den erdmagnetischen Erscheinungen, bearbeitet und herausgegeben von Dr. B. Weinstein. Braunschweig, Friedrich Vieweg & Sohn, 1900.

international polar year 1882–3 made at Kingua-Fjord, South Georgia and Fort Rae.

The discussion of the earth-currents is based upon the tabulated hourly ordinates from the curves. Instead of measuring a single ordinate for each hour, a planimeter was employed, covering a region on each side of the ordinate sought. A further reduction, by means of trigonometric series, was carried out, in order to get a still closer approximation to the true hourly values.

The diurnal variation of the earth-currents was well marked, showing two principal maxima, and two secondary. An examination of the equations for the mean diurnal variation for the different years shows a slight systematic change from year to year. The mean variation for each year is prettily shown in the excellent vector diagrams, which are a feature of the work. All of the curves show a motion in the direction of the hands of a watch, and in the details of configuration the agreement is also good. A number of interesting deductions are drawn, indicating the dependence of the phenomena upon the Sun's position.

This dependence is no less clearly shown by the annual change in the diurnal variation. A principal maximum of current intensity occurs at the time of the vernal equinox, a secondary one at the summer solstice. The principal minimum is at the winter solstice. The east-west and south-north components for the diurnal variation are very similar throughout the year. As the Sun moves north, the principal waves in the diurnal variation become more pronounced, the secondary waves less so. In winter the reverse is the case, making the winter curves the more complicated. Similar fluctuations are shown in the coefficients of the trigonometrical representation, as well as by a series of vector diagrams for the months and the seasons. The latter are particularly interesting, showing that the mean current in winter is only about half as strong as in summer. Changes of a few days' duration in the character of the curves also occur frequently, which the author attributes to the varying relative position of nonhomogeneous portions of the Sun, with reference to the earth.

A patient study was made of the diurnal variation, bringing to light the existence of 36 secondary waves in the course of a day. These occurred about 11 minutes later in the north and south than in the east and west line. The exact number of wavelets may be open to doubt, for the personal equation carries great weight in such investigations; but at least the existence of a system of regularly occurring secondary waves seems established.

The second part of the work is devoted to a discussion of the magnetic records from the stations already mentioned, and the connection between them and the earth-currents. The method of treatment is essentially the same as with the earth-currents, the three rectilinear components of the total intensity being considered. A study of the diurnal variation by means of vector diagrams reveals a more or less definite connection with the Sun's motion. In discussing the direction of the variation, two systems of coordinates are used: First, the 'geopolar,' given by the hour-angle and latitude of the point where the direction at any hour cuts the Earth's surface; and second, the 'heliopolar,' in terms of the angle with the Sun's direction (heliopolar distance), and the angle which the plane through the direction at any hour and the Sun makes with the equator. The track of the diurnal variation upon the Earth's surface is described in detail, and shows interesting similarities between the different stations. The vector diagram of the total variation is also resolved into components in the directions of the planes of the equator, the meridian, and a plane perpendicular to both; in each case the dependence upon the Sun's position is well marked. The vector diagram in heliopolar coordinates takes the form of a conical surface around the Sun. The variation vector sometimes makes an angle as great as 90° with the direction of the Sun, but never points directly toward it, from which the conclusion is drawn, that if the Sun is the cause of the variation, the influence can not be exerted along a straight line from the Sun to the Earth. We must pass over the many interesting details in the results from the different stations, merely noting that the vectors for the diurnal variation at Fort Rae move in a direction opposite to that at all other stations.

The study of the course of the magnetic variation throughout the year makes it appear that all phenomena occurring in any one season in the southern hemisphere do not, as was formerly supposed, correspond to those of the opposite season in the northern; on the contrary, certain features in the yearly variation seem to indicate the presence of influences outside the Earth, affecting the Earth as a whole. The dependence of the variation upon the latitude of the station is brought out with great clearness.

The above results have an important bearing upon Schuster's theory of the diurnal variation. This theory, as von Bezold has pointed out, requires an *invariable* system of forces, in whose field the Earth rotates. Weinstein's deductions show that excessive deformations of the system would be needed to account for some of his observed phenomena, so excessive, in fact, as to lend strong evidence in favor of local influences. We must therefore assume at least two systems of forces, one external, possibly subject to variations, the other of local character.

This part of the work concludes with a discussion of secondary magnetic waves, of which, for Wilhelmshafen in 1884, a mean of 36 were detected in the course of a day, in the case both of declination and of horizontal intensity. The connection between waves in the two elements could not however be established with certainty. It is at least significant that the number of secondary waves here is the same as in the case of the earth-currents.

The work reaches its culmination in Part III., where the relation between terrestrial magnetism and earth-currents is discussed. We regret that space does not permit a more extended review of this interesting chapter. To test first the hypothesis that the earth-currents are simply inductive currents caused by changes in the Earth's magnetism, the author compares the mean diurnal variation in vertical intensity for Vienna in 1884, with that of the earth-currents for the same year. Instead of maxima in increase of vertical intensity corresponding to maximal current, etc., we find almost the reverse to be the case. The author therefore confines himself to the question whether variations in magnetism are partly due to the earth-currents. If the *vertical* component of the current changes were known, the problem would be much simplified; in lieu of this, ingenious methods have to be resorted to in order to gain such circumstantial evidence as is possible. Even in a horizontal direction only the mean components for certain distances in two directions are known, while the true path of the current lies wholly in the dark. An increase in one or both of these components would not of necessity cause an increase in any one of the magnetic elements, since any such effect might be more than counterbalanced by changes in the direction of the earth-current.

A comparison of the mean absolute values of vertical magnetic intensity and earth-current intensity for the 24 hours tends to strengthen the theory. To explain certain peculiarities in the former, assumptions are made concerning the variation in direction of flow of the earth-currents, which in turn would require an increase in the magnetic horizontal intensity; and this increase is in fact found to take place. When the changes in azimuth of the horizontal components of earth-current and magnetic intensity are compared, the evidence is weaker, though still in the same direction. The comparison of changes from season to season is also favorable, certain minor variations agreeing remarkably well.

As concluding evidence, reference is made to the parallelism in the occurrence of sudden disturbances. By picking these out on the declination traces in Vienna and comparing them with corresponding disturbances on the Berlin earth-current records, the difference in longitude between the two cities could be quite accurately determined. A rigid comparison would of course be possible only if both direction and amount of the resultant disturbances were known, which is far from being the case in the present state of the science.

The author states his conviction that almost the whole of the variations observed by magnetometers are due to earth-currents which act upon the instruments as upon galvanometers. An immense amount of patience and skill has been devoted to the compilation of results, and it must be admitted that the evidence is favorable to this theory. As a working hypothesis it may be found of great value; but our knowledge of the phenomena, and particularly the mass of actual observations, must be vastly extended before we can finally accept the solution as a physical fact.

W. G. Cady.

U. S. Coast and Geodetic Survey,
Magnetic Observatory, Cheltenham, Md.,
December 21, 1901.

The Birds of North and Middle America: A Descriptive Catalogue of the Higher Groups, Genera, Species and Subspecies of Birds known to occur in North America, from the Arctic Lands to the Isthmus of Panama, the West Indies and other Islands of the Caribbean Sea, and the Galapagos Archipelago. By Robert Ridgway, Curator, Division of Birds, U. S. National Museum. Part I. Family Fringillidæ—The Finches. Washington, Government Printing Office. 1901. Bulletin of the United States National Museum, No. 50. 8vo. Pp. xxxii + 715, pls. 20.

The geographical scope and general character of this important work is well indicated by the above transcript of the title-page, which does not, however, give an adequate idea of the amount of labor involved in its preparation, which has largely engaged the author's attention for the last twenty years, and for the last six years has occupied the greater part of his time. The present volume is the first of the series of eight required to complete the work, averaging about 800 pages and some twenty plates to each volume. As much of the drudgery of collating references, and taking measurements, for the 3,000 species and subspecies comprised in the work, has been mostly completed, it is expected that the publication of the remaining volumes will proceed with little further delay.

The present volume treats only of the single family Fringillidæ, or Finches, which number 389 species and subspecies, of which about one-half occur in North America, the rest being exclusively birds of 'Middle' America. The introductory matter comprises an appropriate dedication to the late Professor Baird, followed by a preface of seven pages, stating the principles that have guided the author in his work, with other explanatory matter. The author has to regret the necessity of beginning his work with the highest instead of the lowest forms, owing to the lack of adequate facilities for arranging the collection of birds in the National Museum, the larger birds being inaccessible for study. This state of affairs has existed for some ten to fifteen years, greatly to the regret and inconvenience of many ornithologists besides the curator, and affords a striking commentary on the neglect by the government of our great but inadequately housed National Museum.

The first twenty-five pages of the main text are devoted to a critical consideration of the classification of the class Aves, with diagnoses and keys for all the higher groups, and for the families of the Oscines. His system is admittedly eclectic, but is on the whole a quite satisfactory compromise. The Fringillidæ, as defined by Mr. Ridgway, embrace several finch-like genera usually referred to the Tanagridæ, but which seem to fit better as members of the Fringillidæ; yet, with these transfers, there is still no hard and fast line of division between the two groups.

Mr. Ridgway's work is strictly systematic and technical. Aside from the descriptions of the forms, the elaborate keys, and the statements of range, a special feature is the very full bibliographical citations, which constitute a large part of the text, and include all references of any value, thus forming an index to the literature of each species. The locality to which a citation relates is stated whenever possible, thus greatly facilitating the labors of future workers. In compiling the references extreme exactness has been attempted in all matters of orthography and nomenclatural combinations—a feature often neglected, but of the highest importance. As Mr. Ridgway observes: "Anyone who has had occasion to verify citations must know that the amount of inaccuracy and misrepresentation in current synonymies, even the most authoritative and elaborate, is simply astounding. They abound with names which do not even exist in the works cited, with those which do not correspond with the originals in orthography, with others that have no use or meaning whatever, being evidently culled from indices without reference to what their status may be on the pages indicated."

In matters of nomenclature the author has followed the American Ornithologists' Union 'Code of Nomenclature,' which has 'been strictly adhered to in all respects.' He has, however, reached different conclusions, in a few cases, regarding the status of certain forms, from those of the A. O. U. Committee. Considering the large amount of time he has been able to give to such points, aided by access to all of the available material, the benefit of the doubt may be safely permitted to rest with Mr. Ridgway, till some equally competent expert, with superior resources, reverses his conclusions.

The 20 plates give outline figures of the bill, feet, tail and wings of each genus treated, and are thus a valuable aid to the student. The work in all its details shows the author's characteristic and well-known thoroughness of treatment, and ornithologists the world over will wish him health and strength to complete the enormous undertaking involved in the preparation of the 'Birds of North and Middle America.'

J. A. A.

SCIENTIFIC JOURNALS AND ARTICLES.

The American Naturalist for January begins with an article on 'Prehistoric Hafted Flint Knives,' by Charles C. Willoughby, describing various forms of these implements; Douglas H. Campbell discusses 'The Affinities of Certain Anomalous Dicotyledons' and J. H. Comstock and Chujiro Kochi present a long and careful study of 'The Skeleton of the Head of Insects,' using the known facts of embryology to give a clearer idea of the structure of the head, attention being mainly given to representatives of the more generalized orders of insects. The article is well illustrated and a long list of references is appended. R. W. Shufeldt contributes a paper 'On the Habits of the Kangaroo Rats in Captivity,' and under the title 'A Contribution to Museum Technique' S. E. Meek describes the method of mounting fishes for exhibition in flat jars, the specimens being hardened in alcohol, then painted with water-colors and then replaced in alcohol.

The Plant World for December, 1901, contains 'Farther Notes on Trees of Cuba,' by Valery Havard, with a fine plate of the silk cotton tree; 'Notes on the Pan-American Exposition,' by Pauline Kaufman, in which we are sorry to see an account of a 'petrified body'; 'The Flora of Snow Cañon, California,' by S. B. Parish, besides the customary Briefer Articles, Notes and Reviews. In the Supplement Charles L. Pollard continues the description of the families of the order Parietales.

The Museums Journal, of Great Britain, contains a brief biographical sketch of Dr. Henry Woodward, who has just retired from the keepership of the department of geology in the British Museum. J. G. Goodchild describes, under 'Astronomical Models in Museums,' a practical orrery on a rather large scale devised by him for the Edinburgh Museum of Science and Art, and D. P. H. discusses 'Hygiene as a Subject for Museum Illustration,' giving an outline of the method and objects of such an exhibit. There are a few short articles and numerous notes on Museums in various parts of the world.

The American Museum Journal for November–December continues L. P. Gratacap's paper on 'The Development of the American Museum of Natural History,' and deals with the department of vertebrate palæontology. Other articles deal with recent work of the Museum, and the number has a well-illustrated supplement on 'The Saginaw Valley Collection,' by Harlan I. Smith, which is to serve as a visitors' handbook.

Following the death of Dr. Charles Henry Brown, the former proprietor of the *Journal* of *Nervous and Mental Diseases,* Dr. Smith Ely Jelliffe of New York has become the responsible editor. Dr. William Osler, Dr. Frederick Peterson and Dr. Wharton Sinkler have joined the advisory board. Dr. William G. Spiller of Philadelphia will continue to be acting editor.

SOCIETIES AND ACADEMIES.

THE AMERICAN PHYSICAL SOCIETY.

THE Annual Meeting of the Physical Society was held at Columbia University on Dec. 27, 1901. From some points of view the date was an unfortunate one, coming as it did so soon after Christmas day. But in spite of this fact the attendance was unusually good, while the program included a larger list of papers than that of any previous meeting except the one held in connection with the New York meeting of the American Association in 1900.

Officers were elected for the year 1902 as follows:

President, Albert A. Michelson; *Vice-President,* Arthur G. Webster; *Secretary,* Ernest Merritt; *Treasurer,* William Hallock.

Messrs. Carl Barus, D. B. Brace and A. L. Kimball were elected members of the Council of the Society.

The following papers were read:

'A Suspected Case of the Production of Color by the Selective Electrical Resonance for Light Waves of Very Minute Metallic Spheres': R. W. WOOD.

'Report on Electrostriction': LOUIS T. MORE.

'Further Experiments on Electrostriction': J. S. SHEARER.

'The Transmission of Excited Radioactivity': E. RUTHERFORD.

'Excited Radioactivity and Ionization of Atmospheric Air': E. RUTHERFORD and S. J. ALLEN.

'Note on Drude's Elektronentheorie': E. H. HALL.

'The Disturbances of a Plumb-bob suspended on a Steel Wire': WM. HALLOCK.

'A Thermograph for Earth Temperatures': WM. HALLOCK.

'The Viscosity of Water determined by the Aid of Capillary Ripples': F. R. WATSON.

'Magnetization of Steel at Liquid Air Temperatures': C. C. TROWBRIDGE.

'The Pfanndler Calorimeter': W. F. MAGIE.

'Standards of High Electrical Resistance': H. C. PARKER.

'Variation of Contact Resistances with Change of E. M. F.': H. C. PARKER.

'On a Ruling Engine for Diffraction Gratings': A. A. MICHELSON. (Read in abstract by the Secretary.)

The next meeting of the Society will be on Feb. 22, at 10:30 o'clock A. M., in Fayerweather Hall, Columbia University.

ERNEST MERRITT,
Secretary.

OHIO STATE ACADEMY OF SCIENCE.

THE eleventh annual meeting was held at Columbus, November 29 and 30. This was a month earlier than the usual time but the attendance was as good as usual, about thirty-five. The policy of holding a summer field meeting every year the Academy decided to abandon. Some of these meetings have proved very successful, but of late the attendance of members living at a distance has been small, except when held in connection with the meeting of some other organization. Hereafter the executive committee each year may or may not call a summer meeting.

The following resolution was passed: "That the Academy, through its secretary, respectfully represent to the postal authorities that the present provisions and rulings of the postal department regarding transmission of natural history specimens are inconsistent and a serious hindrance to exchange of scientific material and urge that better provisions be afforded."

The secretary read obituary notices of Edward W. Claypole, first president of the Academy, and of Mrs. Claypole, and a committee was appointed to draft a suitable memorial.

A letter was read from Emerson E. McMillin, again placing $250 at the Academy's disposal. Eighteen persons were elected to membership.

The topographic survey of Ohio by the U. S. Geological Survey in cooperation with the State was begun in 1901 as a result of determined efforts put forth by the Academy of Science beginning in 1896, when Albert A.

Wright made the matter the subject of his presidential address. The progress of the topographic survey during the past season was described by C. N. Brown. The report of the Committee on Topographic Survey, prepared by Albert A. Wright, the chairman, was read by Lynds Jones. In conclusion it says: "It is very desirable that the members of the Academy and all other supporters of the survey, should make known, to their representatives in the legislature and to the governor and other officers of the State, their desire that this work, so well inaugurated, should be followed out to its completion, in the mapping of the entire area of every county of the State."

The following officers were elected for the ensuing year: President, W. R. Lazenby; Vice-Presidents, C. J. Herrick and C. S. Prosser; Secretary, E. L. Moseley; Treasurer, Herbert Osborn; Elective Members of Executive Committee, Wm. Werthner and John Uri Lloyd.

The program was as follows:

'New Fossils, including Sea-weeds, two new genera, Carboniferous, Marietta; Land Plants, two species, Carboniferous, one species, Corniferous; Corals, fifteen Cyathophylloids, Corniferous; Brachiopods, one, Corniferous; Cephalopods, six, Corniferous': H. Herzer.

'Notes on the timber of trees of Ohio': William R. Lazenby.

'The self-pruning of woody plants': John H. Schaffner.

'The Ohio species of *Phyllachora*': W. A. Kellerman and J. G. Sanders.

President's Address—'The Future of Vegetable Pathology': A. D. Selby (will be published in Science).

'A striking case of mimicry, with exhibition of specimens': Herbert Osborn.

'Smut infection experiments': W. A. Kellerman and O. E. Jennings.

'Further observations on the preglacial drainage of Wayne and adjacent counties': J. H. Todd.

'The weight, waste and composition of apples': William R. Lazenby.

'Plant ecology of Ohio; a general outline': John H. Schaffner and Fred. J. Tyler.

'Observations on the flora of the Gauley Mountains, West Virginia': W. A. Kellerman.

'Preliminary list of tamarack bogs in Ohio': A. D. Selby.

'Report for 1901 on the State Herbarium with additions to the Ohio Plant List': W. A. Kellerman.

Joint Meeting of the Academy of Science and the Modern Language Association of Ohio. (Three titles.)

'Modern Languages and Science in High School Course': William Werthner.

'Botanizing in the Colorado Mountains'—Illustrated: A. D. Selby.

'Some notes on a trip to southeastern Siberia': Gerard Fowke.

'Notes on Hemiptera with some records of species new to the Ohio list': Herbert Osborn.

'Observations on some South American Hemiptera, with exhibition of specimens': Herbert Osborn.

'A species of Diptera mining the leaves of wild rice at Sandusky': Jas. S. Hine.

'Experiments with chemicals to improve seed germination': W. A. Kellerman and F. M. Surface.

'A possible cause of Osars': G. H. Colton. Read by the secretary.

'The introduced species of *Lactuca* in Ohio': A. D. Selby.

'Gradations between *Verbena stricta* and *Verbena angustifolia*': Thos. A. Bonser.

'New plants for the Ohio Catalogue': A. D. Selby.

'Observations on the origin of forest belts in Clay County, Kansas': John H. Schaffner.

'A report on the Revised Catalogue of Ohio Birds': Lynds Jones.

'The summer birds of Lake Erie's Islands': Lynds Jones.

'Perverted Benevolence': Gerard Fowke.

'Notes on *Anthurus borealis* and *Erysiphe graminis*': W. W. Stockberger.

'Report on Ecology of Big Spring Prairie': T. A. Bonser.

'Some aspects of plant growth as illustrated by methods of watering': W. J. Green. Presented by the president.

Shall we continue the field meetings?

What places of interest to scientists or to the general public are in need of protection by the State?

In what manner may the Academy become more serviceable to the scientific interests of the State?

'An insect pest new to Ohio': F. M. Webster. Read by title.

'The trend of insect migration in America': F. M. WEBSTER. Read by title.

'A plasmodium found in the blood of a turtle and related to the plasmodium of malaria': C. B. MORREY. Presented by Herbert Osborn.

E. L. MOSELEY,
Secretary.

NEW YORK ACADEMY OF SCIENCES.
SECTION OF BIOLOGY.

A REGULAR meeting of the Section of Biology was held on January 13, Professor Charles L. Bristol occupying the chair. The following program was presented:

1. 'The Relation between the Variability of Cells and that of Organisms': FRANZ BOAS.

2. 'Degeneration in *Paramœcium* and so-called Rejuvenescence without Conjugation': GARY N. CALKINS.

3. 'Natural Selection in *Samia cecropia*': HENRY E. CRAMPTON.

Professor Boas, in his paper, which has been printed in full in SCIENCE for January 3, 1902, established the following conclusions: "(1) The elements of organisms are more variable than the organisms themselves. (2) The elements of organisms vary in correlated groups. (3) The characteristics of the variability of an organism depend upon the correlations of its constituent elements, so that a knowledge of these correlations will enable us to determine the characteristics of the variability of the organism." (4) It was also pointed out that skew distribution of variations does not necessarily indicate selection, or instability of type, but may occur in stable forms.

Dr. Calkins presented the history of two individuals, *A* and *B*, of *Paramœcium caudatum*, from different localities, which were isolated February 1, 1901. These were fed on twenty-four hour hay-infusion, and the number of divisions recorded at periods of from one to three days throughout the year, one individual being isolated each time. Conjugation occurred for the first time, among the extras, in May. This period was followed, in July, by well-marked degeneration of both *A* and *B*, which went so far that nearly all of the stock was lost. The survivors were stimulated to renewed activity by treatment with extract of lean beef. After three months of normal and active divisions, another period of conjugation occurred. This again was followed by degeneration and again the cultures were saved by treatment with beef-extract. At the present date (January 13), *A* is in the 416th generation, and *B* in the 375th generation, and no conjugation has taken place in the direct line of the cultures. Thus far the experiments have yielded the following results: (1) *Paramœcium* unquestionably passes through more or less regular cycles of activity and weakness. (2) The period of weakness is preceded by one of greater dividing activity. (3) The period of weakness ends in death, provided the diet (hay-infusion) remains the same. (4) Beef-extract, without conjugation, restores the weakened functions of growth and division. (5) Exogamous conjugation of *A* and *B*, if followed by the same diet (hay-infusion), does not restore these weakened activities, but is soon followed by death. (6) Exogamous conjugation between wild gametes, and followed by hay-infusion diet, results in normal growth, division, and life. (7) Endogamous conjugation among gametes from the cultures does not differ from exogamous conjugation. The ex-conjugants live and divide normally if fed for a time with beef-extract, but die if fed directly with hay-infusion. (8) One intra-cellular effect of beef-extract upon weakened *Paramœcium* is the formation of 'excretory granules.' Another is the disintegration of the old macronucleus. (9) A few conclusions to be drawn are: (*a*) a change of diet is necessary for the continuance of vital activities; (*b*) the equivalent of parthenogenesis in higher animals may be induced by change in diet; (*c*) conjugation, by itself, does not 'rejuvenate'; (*d*) conjugation probably has some other significance than that usually accepted, though what this significance may be is not indicated, thus far, by the experiments.

Professor Crampton presented the results of a statistical study upon pupæ of *Samia cecropia*. Twenty-five characters were determined for a lot of 456 pupæ, the measurements were tabulated, and the usual constants of the curves of variation were ascertained, viz., the range, mode, mean, standard deviation and coefficient of variability. It was found that only 349 of these pupæ produced perfect moths at the time of metamorphosis, the others being imperfect to a greater or less degree, and therefore presumably ruled out as far as reproduction is concerned. When, now, the former class was compared, sex by sex, with the whole group of pupæ, it was found to be a selected class of the less variable individuals, while the more variable ones were eliminated. Selection is therefore 'periodic' in the sense of Pearson. The fact of primary interest appears when this case is contrasted with that of *P. cynthia*. As reported last spring, selection in the latter species is similarly of the less variable individuals, but is 'secular' as well, that is, the perfectly metamorphosing pupæ form a class by themselves, with a type which differs from that of the whole group. It was pointed out that the real basis of selection was probably a correlative one, a physiological 'fitness' depending upon the proper coordination or correlation of the various parts of the organism.

HENRY E. CRAMPTON,
Secretary.

SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY.

THE Section met at the Chemists' Club on the evening of January 6. Mr. H. C. Parker gave the results of some experiments he had made on the 'Variation of Contact Resistance with Change of Electromotive Force.' The resistances used in the experiments consisted of oxide of manganese on cobalt glass, the new form of standard high resistance described in a previous paper given before the Academy. The electromotive forces employed consisted of 10, 50 and 100 dry cells, respectively. It was found in every case that the resistance decreased with increase of electromotive force. This decrease might be only a small percentage, or the resistance might be reduced to a small portion of the original value. Improving the contacts rendered this change in resistance much less marked. It was stated that the decrease in resistance when the electromotive force was increased might possibly be due to a kind of coherer action taking place at the contacts. Very high resistances, measured by the electrometer method, were found to practically obey Ohm's law. It was pointed out that in such cases the contact resistance was probably only a small portion of the entire resistance.

Professor Hallock presented a paper on the 'Magnetic Deflection of Long Steel Wire Plumb-lines.' He stated that in the course of the work in the very deep shaft of the Tamarack Mining Co. on Lake Superior it had been found desirable to plumb down certain points from the surface. The plumb-lines used were of No. 24 piano wire and the weights were fifty pounds of iron. At first the lines were 16.33 feet apart at the top and they were later moved to 17.66 feet. The remarkable observation was made, that in the first case they were 0.08 ft., and in the second case 0.07 ft., further apart at the base than at the top. It was pointed out that a deflection of such an amount could not be explained as due to the gravitational attraction of the walls of the shaft for the nearer plumb-bob. Professor Hallock suggested that the effect was probably due to the magnetization of the wire and the consequent repulsion of the north poles at the bottom. In order to test the possible applicability of this theory a number of experiments were made in the research shaft at Columbia University which gave much corroborative evidence. Two plumb-lines about 85 ft. long were suspended in the shaft. One was of copper wire and the other of iron wire, about 0.03 in. in diameter. Lead weights were attached and it was found that the lines were about $\frac{1}{75}$ in. closer together, at the bottom, when the iron line was south of the copper than when it was north. Two lines of iron wire were also used and the distance apart at top and bottom measured. The deflections obtained were of the same order of magnitude as those produced by the earth's field. The deflections, thus obtained, give evidence of the action of magnetic forces of sufficient magnitude to explain the deviations observed in the plumb-lines in the Tamarack shaft.

Professor Hallock also described a form of recording thermometer which he had lately devised. It consists of a large copper bulb which was connected by means of capillary copper tubing to a series of cells similar to those used in the construction of aneroid barometers. The bulb, tube and cells, were filled with oil and the recording mechanism attached to the aneroid cells.

F. L. TUFTS,
Secretary.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

AT the 545th meeting, held on January 18, 1902, Mr. L. P. Shidy, Chief of the Tidal Division, Coast and Geodetic Survey, gave a brief 'Explanation of the Currents in Unalga Pass, Aleutian Islands, Alaska.' Dr. Dall spoke of the difficulties of navigation in this pass when there is a strong current, and of the unaccountable dying away of the wind near the center of the pass.

He said that these currents seem to conform to Torricelli's theorem for the flow of liquids due to a difference of head, which may be expressed thus:

$$V=\sqrt{2gd}\text{ feet per second,}$$

where g=32.1722 feet=the velocity of a falling body at end of first second, and d=the difference in feet between the elevation of the water surfaces at each end of the strait.

If we extract the square root of $2g$, we have

$$V=8.0215\sqrt{d}\text{ feet per second,}$$

or converting this into nautical miles per hour, it becomes

$$V=4.75\sqrt{d}\text{ knots,}$$

in which d is expressed in feet, as before.

The tides at each end of Unalga Pass were tabulated in the accompanying table.

The computed velocities of the current in the given table were obtained by the application of Torricelli's theorem. It may be remarked that there is, in general, a satisfactory agreement between the observed and computed velocities. The times of changing direction of flow are correctly given by computation, and the interesting phenomenon which occurred at 16 hours on June 14, 1901, where the southerly current had decreased to 1 knot, and then increased again without reversing its direction, is reproduced by computation within small limits of error.

TIME.	TIDE.		CURRENTS. + Indicates a Northerly Current. — Indicates a Southerly Current.	
12=Noon.	South End of Pass.	North End of Pass.	Computed.	Observed.
Hour.	Feet.	Feet.	Knots.	Knots.
June 14, 1901				
8	3.14	2.91	+ 2.3	+ 2.6
9	3.75	3.20	+ 3.5	+ 3.7
10	4.38	3.87	+ 3.4	+ 3.1
11	5.00	4.69	+ 2.6	+ 1.9
12	5.66	5.63	+ 0.8	+ 0.6
13	6.31	6.38	— 1.2	— 1.1
14	6.86	7.12	— 2.4	— 2.4
15	7.21	7.34	— 1.7	— 1.7
16	7.20	7.28	— 1.3	— 1.0
17	6.84	7.03	— 2.1	— 1.8
18	6.68	6.89	— 2.2	— 2.0
June 15, 1901				
8	2.86	3.17	— 2.6	— 2.4
9	3.02	3.06	— 1.0	— 0.5
10	3.78	3.22	+ 3.6	+ 3.8
11	5.22	3.75	+ 5.7	+ 5.8

Professor J. H. Gore gave an account of the proposed 'Draining of the Zuider Sea,' illustrated by many lantern slides. The old plans have been found commercially impracticable, and the plan definitely recommended by a large Commission appointed in 1892 is the following: Only those portions are to be reclaimed that have a clay bottom; this leaves free the mouths of the rivers and the present lines of water communication. First, a great sea dyke should be built at the north end with many locks, and with sluiceways to allow drainage at low tide; this will require some ten years and cost $16,000,000. Then a tract of 52,000 acres in the N. W. part should be dyked and drained, requiring five years and $5,000,000. Continuing the work, in all about a million and a quarter acres would be reclaimed in thirty-three years' time at a cost of $69,000,000. Experience shows that such lands can be rendered arable in about three years; and it is estimated that they could be rented by the state at $7 per acre per year. The report is a model of thoroughness for its consideration of every interest involved. The project now awaits the consideration of the legislative body.

Charles K. Wead,
Secretary.

THE ELISHA MITCHELL SCIENTIFIC SOCIETY.

The Society held its one hundred and thirty-eighth meeting on Jan. 21 at the University of North Carolina. The following papers were read:

'Recently Discovered Minerals in North Carolina': J. H. Pratt and Collier Cobb.

'Arizona, Its Mineral Wealth': J. H. Pratt.

Chas. Baskerville,
Secretary.

DISCUSSION AND CORRESPONDENCE.

THE DAILY BAROMETRIC WAVE.

In the *Monthly Weather Review* for Nov., 1901, Dr. O. L. Fassig has an interesting article on 'The Westward Movement of the Daily Barometric Wave.' The article is illustrated by charts showing the lines of equal pressure departure in the western hemisphere for each hour of the day for the month of July. Dr. Fassig's study was suggested by my own paper on the eclipse cyclone and the diurnal cyclones, but he was the first to complete charts of this kind and his charts add much to a knowledge of the behavior of the daily barometric wave and will no doubt aid materially in clearing up the cause of this wave.

The charts show very clearly that the diurnal areas of high and low pressure have distinct centers like the cyclones and anticyclones of the weather map, but unlike the latter move rapidly toward the west instead of toward the east. Moreover, the charts show very strikingly the effect of ocean and continent on the depth and position of the diurnal areas of high and low pressure, and one can scarcely doubt that surface heat and cold play a very important part in their formation.

Particularly instructive in this connection is the behavior of the early morning minimum of pressure. At 2 a. m., 75th meridian time, it is chiefly over the two Atlantic oceans, and is central over the North Atlantic, the cold ocean at this time of year when contrasted with the surrounding continents. Between 3 a. m. and 6 a.m. this barometric minimum passes over the land areas of North and South America and then the low pressure is found central over the cold southern continent where winter prevails, and the pressure scarcely falls below normal in the warmer northern continent. These facts appear to point very clearly to the dependence of this depression on a relatively low surface temperature, and are in line with the suggestions in my papers on the eclipse cyclone and the diurnal cyclones, namely that the morning minimum of pressure is the result of a cold air cyclone.

The afternoon barometric minimum moves from South America to North America during the afternoon following the place of highest temperature, thus indicating its dependence on surface heating.

Mr. Fassig does not state from what source his data are obtained. In drawing my own charts I have found a great scarcity of data from over the Pacific Ocean. The data for South America will be greatly added to when Professor Bailey's observations are published in the Harvard *Annals.* In constructing my own charts I scaled off the values at his stations from the curves published by him in the *American Meteorological Journal,* Vol. XII., p. 331.

H. H. Clayton.

NOTES ON INORGANIC CHEMISTRY.

NEW BORIDS.

AMONG the compounds which the high temperature of the electric furnace has rendered easy of preparation are the borids of the metals, few of which were known until within the last decade or so. Moissan has described the borids of the alkaline earths, of iron, nickel, and cobalt, and of carbon and silicon. In the last number of the *Journal of the Chemical Society* Tucker and Moody recount the preparation of the borids of chromium, molybdenum and tungsten, and of zirconium. All were made by heating the mixed elements in the electric furnace, and are crystalline bodies of great hardness; they are but slightly attacked by hot concentrated acids, except that the molybdenum and tungsten borids are vigorously acted on by hot aqua regia. The formulas obtained by analysis are, CrB, Mo_3B_4, WB_2, and Zr_3B_4. The authors suggest that as a consequence of their high fusing point, hardness, and good crystallization, it is quite possible that some of these and other borids may prove to have industrial uses.

ETHYLENE FROM INORGANIC SOURCES.

IN a recent *Journal of the Society of Chemical Industry* the same authors describe the production of ethylene from inorganic sources. Since calcium carbid when treated with water evolves acetylene, and aluminum carbid evolves methane, it was hoped that a mixture of these carbids would give ethylene, but this was found not to be the case; only acetylene and methane were obtained. When, however, a mixture of barium silicid, which evolves hydrogen, with calcium carbid is decomposed by water, ethylene is present in the evolved gases to the extent of two per cent. If barium carbid is substituted for the calcium carbid, the gases contain up to fifteen per cent. of ethylene.

ORGANIC ARAGONITE AND CALCITE.

A NEW reaction to distinguish between aragonite and calcite is given by W. Meigen in the *Centralblatt für Mineralogie*. The finely powdered substance is boiled for a few moments with a dilute solution of cobalt nitrate. In the presence of aragonite a lilac red precipitate of basic cobalt carbonate is formed, while calcite remains uncolored even after prolonged boiling, or is occasionally colored yellow. Magnesium carbonate is also unchanged in color and calcium phosphate gives a blue precipitate. Using this diagnostic reaction upon shells, corals, and other animal remains, both recent and fossil, the author gives long lists of those consisting of aragonite and calcite respectively. No rule of distribution is apparent from his lists; most orders, recent and fossil, are represented in both classes. The larger number of corals are aragonite, but corallium and tubipora are calcite; the outer shell of trigona is calcite while the inner shell is aragonite; the argonauts are calcite but nautilus and sepia are aragonite; hens' eggs are calcite.

UTILIZATION OF FLUORIN FROM FERTILIZER PLANTS.

WHEN natural phosphates are decomposed by sulfuric acid in the manufacture of superphosphate fertilizers, there is a considerable quantity of hydrofluoric acid set free as such, or as fluorid of silicon. This is especially the case when apatite is used; indeed this fact detracts very materially from the value of the immense apatite deposits of Canada. In Germany manufacturers are compelled by law to prevent the escape of these deleterious gases into the atmosphere and efforts are being made to utilize the waste product. By leading the gases through water, fluosilicic acid is formed and from this solution sodium fluosilicate or magnesium and aluminum fluosilicates may be readily prepared. The last two have some use in hardening calcareous stone. More recently it has been discovered that fluosilicic acid has strong antiseptic properties and that as a preservative of manure it surpasses plaster, kainite or superphosphate of lime. The denitrifying action of bateria is checked, preventing the loss of nitrogen. The greatest difficulty in the way of its adoption for this purpose is its preparation in suitable form. The aqueous acid in bottles would hardly be acceptable to the farmer and no satisfactory absorbent of the acid has been found. A patent for a new manure preservative has recently been taken out, in which the fluosilicic acid is incorporated with clay, with the bases of which it for the most part combines. With this powder goes another consisting of a porous substance saturated with sulfuric acid. A small quantity of each powder is scattered over the manure pile and by the action of the sulfuric acid on the fluosilicates fluosilicic acid is generated which acts as an antiseptic. In describing this process in the *Chemiker Zeitung* C. Elschner suggests that it would be more economical to absorb the gases directly by lime and then dry the calcium fluosilicate formed, and that a powdered bisulfate could be more advantageously used than sulfuric acid. Should some practicable method be devised for utilizing these noxious gases it would give great value to many apatite deposits which contain too much fluorspar to be utilized at present.

A GYPSUM WEATHER-SCALE.

Around the 'Stone Gallery' at the base of St. Paul's Cathedral is a balustrade of Portland stone, surmounted by a heavy coping of the same material. All of the stone is greatly weathered and coated with a gray or black deposit, much resembling boiler scale. Under the coping this attains a thickness of three-quarters of an inch. An examination of this deposit is given by E. G. Clayton in the *Proceedings* of the Chemical Society. It contains no fungoid matter, and contrary to expectation no carbonates were found in it. It is essentially calcium sulfate, with a small amount of silica. Since there is no neighboring source of sulfates the conclusion is reached that it has been formed by two centuries' solvent and weathering action of rain, charged with sulfurous and sulfuric acids derived from the gases and smoke of innumerable surrounding chimneys. The rain water, running and dripping from the under side of the coping stone, has here left an especially thick deposit, which presents a curiously close resemblance to a deposit of calcareous tufa.

J. L. H.

CURRENT NOTES ON PHYSIOGRAPHY.

PHYSIOGRAPHY OF WISCONSIN.

Collie has contributed two articles on the physiography of his State. The first ('Physiography of Wisconsin,' *Bull. Amer. Bureau Geogr.*, II., 1900, 270–287) is a general and elementary account, giving fuller statement of features due to glacial action than to those determined by the underlying rock. The second ('Wisconsin shore of Lake Superior,' *Bull. Geol. Soc. Amer.*, XII., 1901, 197–216) is the result of detailed local study, with special reference to shore features in the neighborhood of the Apostle Islands. These islands consist of horizontal sandstones, usually cliffed and caved along the waterline, but also modified by bars and spits, of which the largest encloses Chequamegon bay.

In both these papers the bluff by which descent is made from the northwest border of the uplands of disturbed Keweenawan rocks to the lower land of horizontal sandstones bordering Lake Superior is described as a fault scarp, 'formed by the movement of rocks one upon the other, * * * particularly noticeable because it is not formed, as most of the Wisconsin cliffs are, by erosion.' This interpretation of the recency of the fault is novel. The considerable erosion indicated by the truncation of the upturned edges of the sandstones near the fault line throws some doubt upon the accuracy of Collie's view; should it be proved correct the scarp would be an interesting addition to our physiographic types, for faults that are young enough to preserve something of their initial topographic expression are rare in the eastern half of our country.

GLACIAL EROSION IN SKYE.

The laccolithic mass of the Island of Skye, west of Scotland, was deeply dissected in preglacial time. During the glacial period, its mountains bore local glaciers, whose eastern members stemmed the great ice sheet that came westward from the Scotch highlands, dividing it into two parts which flowed northwest and southwest out to sea. The effects of the Skye glaciers as agents of erosion have lately been studied by Harker ('Ice Erosion in the Cuillin Hills, Skye,' *Trans. Roy. Soc. Edinburgh*, XL., 1901, 221–252, map). He finds that the floors and walls of the ice-scoured valleys exhibit much less relation to rock structure than is usual in districts of subaerial erosion only, and regards this as a natural consequence of the massiveness and relative rigidity of the ice streams. The valleys are comparatively straight, with broad floors and rather smooth and steep sides, heading in amphitheaters or corries that seem unduly large for their drainage areas. The valley floors frequently descend by abrupt slopes to lower and lower levels. Rock basins, excavated in the valley floors, and holding lakes, are justly regarded as subordinate and incidental to the general scouring of the shallower and narrower preglacial valleys to their present trough-like form. Short side glens open characteristically on the walls of the larger valleys to which they are tributary. The divides between the uppermost corries of the main valleys are sharply serrate, in consequence of the retrogressive erosion of the glaciers that headed in the corries, as has been pointed out by Richter for the Alps, and by Matthes for the Big Horn range of the Rocky mountains.

The comparison instituted by Harker between rivers and glaciers is not altogether satisfactory inasmuch as it fails to point out certain similarities between the two. It is stated that, 'the bed of a river which has attained a mature state maintains a steady gradient so long as the volume of water is unchanged'; but it is the surface, not the bed, of the river that should be thus described. The bed of a mature river, such as the Mississippi, has numerous hollows, whose dimensions are to those of the river in about the same proportion as the dimensions of rock basins are to those of the glaciers that scoured them out. When a mature river crosses a reef of resistant rocks, it habitually sweeps out a shallow basin-like depression in the weaker rocks next up stream; while another basin may be eroded by the plunge of the waters down stream from the reef. Rivers whose volume is greatly reduced in the dry season exhibit the hollows in their bed as a series of pools strung together by the diminished stream. It therefore seems wrong to say that 'ice erosion does not, like water erosion, work constantly towards the establishment of an even gradient along a valley.' Both tend to establish even gradients in their surface; both produce inequalities in their beds; the inequalities of a river bed receive little attention; they are comparatively small and are usually out of sight; the inequalities in the beds of existing glaciers are even less open to observation, although it can hardly be doubted that they exist. The inequalities in the beds of extinct glaciers are often so large and so plainly visible that their analogy with the hollows in river beds is too commonly overlooked.

THE SEVERN BORE.

A SERIES of views of the Severn bore taken with a bioscope camera by Vaughan Cornish was thrown on the screen at a meeting of the Royal Geographical Society of London in November last, the first cinematographic illustration of this tidal phenomenon. Four of the views are reproduced in the *Geographical Journal* for January, 1902, and show the approach and passage of the bore with some distinctness. Cornish proposes to make similar studies of other tidal rivers. His well-known studies of rippled sands, under waves, tides and winds have been published in recent years.

W. M. DAVIS.

RETIREMENT OF MONSIEUR HATON.

THE report of the proceedings at a meeting of the faculty, alumni and friends of M. Haton de la Goupillière on the occasion of his retirement from the directorship of l'Ecole nationale supérieure des Mines, accepting Vice-Presidency of the Conseil général des Mines is just distributed. This ceremony took place June 8, 1901, in the great auditorium of the Société d'Encouragement. The list of contributors numbered 580 and the farewell offerings were numerous and various, including a bust of M. Haton and bronzes by Dubois and others. The bust is reported to have proved a very accurate likeness of its distinguished original. The addresses were made by M. Carnot, Director of the Ecole des Mines, and M. Lemonnier, president of the Association.

M. Haton was 'Élève ingénieur' in 1852, when about 20 years of age, was made professor in the preparatory course immediately on graduation as Ingénieur, taught general chemistry in 1855 and mathematics pure and applied; in 1872 he became professor in the course then including machines and exploitation of mines, and became director of the School of Mines in 1887, where he remained until the end of the XIXth century, nearly a half-century of continuous service, substantially all at l'Ecole des Mines. His principal works had meantime been published, on 'Mines and Mining' and on 'Thermodynamics and Motor-Machines.' He had been called to serve on several international juries, and on various commissions, and had earned many honors, including that of Member of the Institute in 1884 and of 'grand-officier' of the Legion of Honor in 1900.

In replying to the cordial and eloquent addresses of MM. Carnot and Lemonnier, M. Haton stated that alumni of the school had supplied 39 members of the Institute and 8 'Correspondents':

"Hommes d'action, hardis explorateurs, chez de grandes industries, ingénieurs chargés de la conduite des travaux ou des affaires, ils soutiennent dans le monde entier le bon renom de l'École."

The *Compte Rendu,* as its frontispiece, has an excellent portrait of M. Haton de la Goupillière. It indicates that its original retains his youth and vigor wonderfully and we may hope for him many more years of active, fruitful and honorable life. His friends in this country will cordially unite with those about him in wishing for him 'many happy new years.'

R. H. Thurston.

SCIENTIFIC NOTES AND NEWS.

Professor E. C. Pickering has completed twenty-five years of service as director of the Harvard College Observatory, and in recognition of the fact the staff of the Observatory has presented him with a silver cup.

The condition of Professor Rudolf Virchow, who recently suffered an injury from a fall, causes apprehension to his physicians.

Dr. W. W. Keen, who is at present in India, recently fell from his horse, fracturing one of his clavicles. The accident was not serious.

The daily papers state that President Roosevelt has overruled the decision of Secretary Long to send Capt. Charles H. Davis, superintendent of the Naval Observatory, to sea.

Dr. Henry B. Kümmel was appointed state geologist of New Jersey by the board of managers of the Geological Survey at their meeting on January 10. Mr. Kümmel has been connected with the Survey since 1892, and since 1899 has been assistant state geologist, being in charge of the work since Dr. Smock's resignation last July. He is a graduate of Beloit College, A.B. 1889, and did post-graduate work in geology at Harvard University, and the University of Chicago, from which he received the degrees of A.M. and Ph.D. respectively. He was elected a fellow of the Geological Society of America in 1895.

Samuel McCune Lindsay, assistant professor of sociology in the University of Pennsylvania, has been nominated for Commissioner of Education in Porto Rico.

The Paris Academy of Medicine has awarded its Hugo prize of $200 for the best work on the history of medicine to Dr. Melanie Lapinska for her book on the history of women physicians.

Dr. Charles H. Burnett, a well-known writer on diseases of the ear, died at Bryn Mawr, Pa., on January 30, aged sixty-one years.

Lieutenant von Siegsfeld, after a balloon ascension from Potsdam to study artificial respiration, was killed in the descent.

The American Philosophical Society, Philadelphia, has arranged for a general meeting on April 3 and 4, and a large number of scientific men from all parts of the country have signified their intention of being present. Members wishing to present papers are asked to communicate the titles to the secretaries without delay, so that they may be inserted in the preliminary program which will be issued as soon after February 15 as practicable. Members expecting to attend the meeting are requested to notify the secretaries at as early a date as possible so as to facilitate the arrangements for their entertainment.

The 'Leopoldinisch-Carolinische Akademie deutscher Naturforscher,' now in Halle, celebrated the two hundred and fiftieth anniversary of its foundation on January 1. The academy, under the name, 'Academia Naturæ Curiosorum,' held its first meeting in Schweinfurt on January 1, 1652, and is thus the oldest academy of sciences north of Italy, the Royal Society having been established in 1662, and the French Academy in 1666. The academy began the publication of proceedings in 1670 and enjoyed extraordinary privileges, the president and secretary being elevated to the nobility, the former with the rank of count. At the present time the Academy has about nine hundred members and is planning for the erection of a new building.

THE Association of American Universities will hold its annual meeting at Chicago on February 25, 26 and 27.

PRESIDENT HADLEY, of Yale University, will give six Lowell lectures at Boston on 'The History of Academic Freedom.'

PROFESSOR B. E. FERNOW, of the College of Forestry, Cornell University, will lecture in Ottawa, Canada, on March 6, before the Canadian Forestry Association.

UNDER the auspices of Columbia University, Professor William D. Burr is giving at the Cooper Union the following lectures on mechanical engineering:

February 4, 'Ancient Civil Engineering Works.'

February 11, 'Bridges.' The latter portion of the lecture will include the treatment of masonry arches and suspension bridges, with examples of applications to the longest spans yet contemplated.

February 18, 'Water Works for Cities and Towns.'

February 25, 'Some Features of Railroad Engineering.'

March 4, 'Nicaragua Route for the Isthmian Ship Canal.'

March 11, 'The Panama Route for the Isthmian Ship Canal.'

The lectures will be issued in book form by the Columbia University Press.

THREE lectures, in German, by Max Uhle, Ph.D., Hearst lecturer in anthropology, and director of the excavations and explorations of the University of California in Peru, are being given as follows:

February 3 and 5, 'The Sources of Ancient Peruvian Civilization.'

February 10, 'Some Incasic Ruins of Central-Peru.'

ARTHUR CURTISS JAMES, ESQ., has purchased the collection of Ainu objects made by Professor Bashford Dean last year and has presented it to the American Museum of Natural History. The Museum has also received from Mr. W. Jochelson, of the Jesup North Pacific Expedition, his Koryak collection from Siberia, consisting of about 1,200 pieces, among which there are many objects of prehistoric age.

PROFESSOR J. S. KINGSLEY, Tufts College, announces that the summer school of biology known as the Harpswell Laboratory, established at South Harpswell, Maine, in 1898, will be open from June 16 to September 13, 1902; the regular courses of instruction beginning July 2, and continuing for six weeks. The laboratory is a small wooden building directly on the shore and affords accommodations for fifteen or twenty students. South Harpswell is in Casco Bay, sixteen miles from Portland, from which place it is reached by steamer. Casco Bay has a rich fauna and flora and is not excelled as a collecting ground by any point between Eastport and North Carolina. Already 529 species of invertebrates have been reported from its waters and many novelties turn up each season. South Harpswell itself is well situated, being at the extremity of a narrow peninsula, ten miles in length, thus ensuring freedom from hot weather. In 1901 the thermometer did not reach 80° in the laboratory.

THE New York State Medical Society at its session in Albany on January 29 received recommendations of the legislative committee as follows:

That local Boards of Health be requested to follow the work of the Milk Committee of the New York City Medical Society in the efforts made to provide pure milk.

That the recommendation making toward the establishment of a National Health Board, with a representative in the President's cabinet, be indorsed.

That the questions involved in Dr. Koch's paper at the London Tuberculosis Congress upon 'The Communicability of Bovine Tuberculosis' invite further experiments in this field before any conclusions can be drawn that would modify existing methods for dealing with the disease.

The report of the library committee for 1901 of the College of Physicians of Philadelphia, as abstracted in the *Philadelphia Medical Journal*, shows 64,916 volumes in the library, including 1,070 duplicates. 4,079 volumes have accumulated since July, when all duplicates on hand were disposed of. In addition to the volumes, there are in the library 58,395 unbound pamphlets, reports and transactions. The library regularly receives 356 medical periodicals, 86 of which are American, and 270 foreign. 2,212 inaugural dissertations have been received during the year.

At a meeting of the Royal Institute of British Architects on January 21, a paper on 'The Recent Architectural Discoveries at Stonehenge' was read by Mr. Detmar Blow, who, with Dr. Gowland, superintended the excavations which were made in October last for Sir E. Antrobus. Mr. Blow, according to the report in the London *Times*, pointed out that the great monolith called the leaning-stone was the largest in England, Cleopatra's needle excepted. It was one of the pillars of the highest trilithon, and stood behind the altar-stone near which it leaned at an angle of 65 degrees. Half-way up it had a fracture one third across it; and the weight of stone above that fracture was a dangerous strain on it. It had now been brought to a vertical position. One Roman coin and one George III. penny were found quite near the surface. Numerous chippings of the sarsen and blue stone of which Stonehenge was built were discovered. The flints found were used for the softer sarsen and blue stones, and the hand-hammers and mauls for rough dressing. From this the deduction had been made that the building belonged to the Palæolithic period. All authorities agreed that it was the work of a highly civilized people. The construction was one of a stone development and the surface of the stone was finished much like that of granite. The design of the pillars was in his opinion evolved from the shapes of the flint instruments used by the workman, to which his hand had grown accustomed. Each pillar had a bold entasis in its elevation, and in its plan foreshadowed the column. With the aid of the illustrations he described the method of raising the leaning stone and the sifting process, the articles found being afterwards shown to the audience. Stonehenge having been generally supposed to be of the bronze age, it was with great joy that he lighted upon the stone implements. It was, he believed, the only occasion on which the implements were found actually next to the stone building where they were used. Sir Norman Lockyer, in opening a discussion on the paper, said he believed archeologists had come to the conclusion that, from the evidence which had been obtained, they were justified in assuming that the sarsen stones were erected in the Palæolithic times—that was to say, before the age of bronze, or at all events before bronze had been used for any ordinary kind of work in that part of England. Before the excavations were commenced Mr. Penrose and himself had been occupying themselves with Stonehenge from a slightly different point of view. They were very anxious to determine its age, and it was found much easier to get certain astronomical data from Stonehenge owing to its position than from other ancient monuments. He gave a number of astronomical data in support of his assumption that Stonehenge was a solar temple and one used for observation in the height of summer. From their observations they came to the conclusion that the avenue which was associated with the sarsen stones was laid down about the year 1680 B. C. Such temples as Stonehenge were erected in the very first blush of civilization in order that the people should be able to fix the time for performing agricultural operations. He thought that Mr. Penrose and himself had been able to show beyond all doubt that we had in Stonehenge a temple for observing the length of the year by observing the rising of the sun on the longest day of the year, although in other parts of England there were temples for observing the sun not on June 21 but early in May and early in August.

The *American Museum Journal* reports

that through the generosity of a friend of the Museum, who desires to have his name withheld from the public, six groups have recently been added to the very attractive and instructive series representing birds amid their natural surroundings which are to be seen in the halls of the Ornithological Department. The new groups represent the American dipper, or water-ousel, the osprey, the yellow-headed blackbird, the coot, Wilson's phalarope and the wild pigeon. The material for the first-named was gathered by Mr. Frank M. Chapman last summer on the banks of a rushing icy stream issuing from a glacier in the Selkirk mountains of British Columbia. The rocky bank of the stream, the nest in the cleft of the rock and the birds in and about the nest have been reproduced with lifelike fidelity in the Museum exhibition case. Mr. Chapman collected the specimens and accessories for the osprey group on Gardiner's Island, off the eastern end of Long Island, and those for the blackbird, coot and phalarope groups at Shoal Lake, Manitoba. The twelve specimens included in the wild-pigeon group were secured with much difficulty from collectors and dealers throughout the country, the surprising fact being incidentally developed that a species which, within the last fifty years, was one of the most abundant native birds of this country, is now so rare, not only in nature, but also in collections, that specimens of it are practically unobtainable. Each of these new groups is designed to illustrate not only the haunts and habits of a species of birds, but also some fact of general biological interest. This feature will be fully set forth in the labels accompanying the cases.

AT the annual meeting of the Mathematical Association, London, Professor A. Lodge read a paper introducing for discussion the subject of improvements in the teaching of elementary mathematics. According to the report in the London *Times* he explained that the special object in bringing the whole question forward now was to enable the Association to cooperate with the British Association committee formed for the purpose at the Glasgow meeting last year. Many teachers had been for a long time aware that the teaching of geometry in this country was suffering from its being based on a fixed ancient model which, however excellent, was not in many respects satisfactory as a text-book for beginners. The efforts hitherto made had been powerless to make any appreciable effect on the action of the great examining bodies in the country, and without their cooperation much progress was not possible. Now, however, with the powerful leverage of the British Association to assist them, the Association might confidently look for real and lasting progress. The best method of teaching geometry would, no doubt, be the question which would require most attention, as that was a matter in which all, teachers and examiners, must move together if at all. Men came up to engineering colleges who were slow and inaccurate in computation, who did not know the contracted methods of multiplication and division, who were as likely as not to put the decimal point in the wrong place. They wanted boys taught to be ready and rapid computers, to be able to make rough checks on their own work so as to avoid gross errors, to cultivate common sense in connection with problems, and to be in the habit of verifying answers. It had to be remembered that the pupil's mental equipment was chiefly arithmetic and algebra, and his geometry should be built on these notions as much as possible, instead of being carefully divorced from them, as was done in so many text-books. It would be advisable at the outset to adopt some French text-book as our model. The Americans had done so already, and the chief points in their books were: (1) The more orderly arrangement of propositions; (2) the entire separation of theorems from problems of construction, hypothetical constructions being used in proving a theorem; (3) the closer association of a proposition and its converse when both were true; (4) the adoption of arithmetical notions and algebraic processes; (5) the early introduction of simple *loci;* (6) insistence on accurate figures drawn by accurate and practical processes; (7) practice in exercises from the very beginning. It had been suggested that he should add, 'Attention paid to the various phases of a theorem as the figure changes, and (as the student progresses) to the easier forms of generalization.' The greater part of these improvements could be adopted at once, provided that the sanction of the great examining bodies could be obtained. In conclusion he urged on all who were convinced that reform in geometrical teaching on some such lines as he had indicated was urgent and imperative that they should not rest content until some at least of the reforms were sanctioned by the great public examining bodies. The meeting ought not to conclude without appointing a strong committee to keep in touch with the British Association committee.

UNIVERSITY AND EDUCATIONAL NEWS.

Mr. John D. Rockefeller has offered to give $1,000,000 toward the construction, equipment and endowment of the new buildings of the Harvard Medical School, on condition that $500,000 be secured from other sources.

Allegheny College has recently added two hundred thousand dollars to its endowment fund through the efforts of the president, Dr. Wm. H. Crawford.

Dr. Nicholas Murray Butler will be installed as president of Columbia University on April 19. The ceremonies will be similar to those on the occasions of the installations of Presidents A. P. Barnard and Seth Low. The charter and keys of the University will be presented by Mr. William C. Schermerhorn, chairman of the board of trustees, to the president-elect, who will respond briefly, and who in turn will be succeeded by speakers representing faculty and alumni. Brief speeches of greeting will be made by Presidents Eliot and Hadley and by representatives of other universities, and the program will conclude with the president's inaugural address.

Rev. Daniel S. Bradley, of Grand Rapids, Mich., has been elected president of Iowa College, Grinnell, Iowa.

The Supreme Court has dismissed the suit of the New York University against the Loomis Laboratory to gain possession of its property.

Owen's College, Manchester, will celebrate in March the fiftieth anniversary of its foundation.

Professor Hugo Münsterberg, as chairman of the philosophical department of Harvard University, is making special efforts to secure funds for the erection of a building for the department, to be known as Emerson Hall. Plans have been drawn by Mr. A. W. Longfellow, according to which the hall is to be a three-story structure, of red brick. On the first floor there will be small recitation rooms and one large lecture hall, seating 400 students. The rest of the floor will be taken up by a philosophical library, comprising an extensive collection of philosophical works. The second story will contain small recitation rooms and seminary rooms for advanced work. The entire third floor will be used for a psychological laboratory. There will be one large room, where work of a general character may be done. The rest of the laboratory will be divided into fifteen sections, each of which will be specially equipped for certain specific branches of the subject.

It appears that the elective courses of the junior year at Yale University have been selected by students, as follows: History 390, English 374, philosophy and psychology 336, social science 323, German 117, French 97, Latin 36, Greek 21, geology 112, chemistry 85. Philosophy and psychology were last year made elective for the first time and are doubtless more popular than when they were required. The classical languages appear to fare badly, for it is probable that only those who carry them into the junior year get an adequate return for required routine work of previous years.

The reorganization of the faculty of the Imperial University at Pekin, with the retirement of President Martin, is contemplated. He criticised the government severely after the siege of the legations, but his age is the principal reason for his removal.

R. J. Paranjpe, the Hindoo who was senior wrangler of Cambridge University three years ago, has returned to his native country, and has been given a professorship at Fergusson College, Poona.

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, FEBRUARY 14, 1902.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*THE RELATION OF THE AMERICAN SOCIETY OF NATURALISTS TO OTHER SCIENTIFIC SOCIETIES.**

WITH the first year of the new century new conditions have arisen which profoundly affect all problems of cooperation between the national scientific societies. The project which emanated from the American Association for the Advancement of Science to establish Convocation Week has made, as you all know, so great progress that we are now meeting for the first time in this week set apart by the action of numerous universities for the purpose. The Association also has sought to establish wider and more numerous affiliations, such as long existed between it and several important national societies. For many years it has been the rôle of the Society of Naturalists to act as the organ of affiliation for societies which are concerned with the various branches of natural history, and which have been accustomed to meet during the Christmas recess. But the Association is now intending to meet at this period and we may safely entrust the function of establishing affiliation between the representatives of the various sciences in America to this larger body which can include all the branches of science.

A few words as to the history of our

* Annual discussion before the Chicago meeting of the American Society of Naturalists and Affiliated Societies.

Society. It was founded in 1883 under the title of the Society of Naturalists of the Eastern United States. It owes its birth to the action of Professor Hyatt in formulating and proposing the plan, in accordance with which the Society was actually organized, and in interesting others in its establishment. The first secretary was Professor S. F. Clark, now of Williams College. The first meeting was a small gathering at Springfield, Mass., on the 10th of April, 1883. Unfortunately Professor Clark was obliged to resign his office as he was going abroad. For some time it seemed doubtful whether the Society would get beyond its first meeting. I was then asked by Professor Hyatt to act as secretary, and during the remainder of that year I carried on an extensive correspondence with the professional naturalists of the country and nearly all of those who were invited accepted membership.

It was then decided to hold a meeting in New York, December 27 and 28 of that same year. We started with 109 original members, of whom there still remain in the Society not less than 39. At the close of the first meeting the membership had risen to 133 and we have now nearly 250. The original scope of the Society was to have papers on methods of investigation, on technique, on museum administration and devices and on methods of instruction; and in fact at our early meetings many such papers, both of value and of interest, were presented. In 1886 the name was altered to '*The American Society of Naturalists.*' You are all familiar with the gradual change which has come about and know that at present our functions at our annual gatherings are confined to a discussion on some topic of general interest, to a social dinner and to the presidential address. Many of these addresses in the past have been of a noteworthy character, and we are anticipating an address from our president this year which will well sustain the high standard set by even his most distinguished predecessors.

The most important achievements of the Society have been somewhat different from what was foreseen at the time of its organization. It has, of course, accomplished a great deal in the general promotion of natural science. Its meetings have done that. But perhaps more important than this somewhat general fact have been certain specific results which have been attained by the Society. It was, I think, the very first society of national scope which confined its membership strictly to professional scientific investigators, and the rule adopted by the Society for determining what constituted a professional naturalist was very strict and has been well enforced. Many other societies have this same quality of membership, having, in many different branches of science, been formed from our example. Collectively they represent the very best that there is at the present time in American productive scholarship. We may, therefore, claim as one of our most essential and significant achievements the generation of our affiliated daughter societies. They are all characterized by a seriousness of purpose and intensity of scientific work, which can not by any means be always matched by what one encounters in the meetings of foreign societies. Our American societies to which I have referred meet for earnest, scientific discussion. They take but little time for anything else. How striking a contrast there is between the meetings now being held, with each day filled by a long series of valuable papers before each society, and the gatherings, such as many of us have attended in Europe, where a few hours only are kept for the strictly scientific meeting, and many for excursions, picnics and balls. I remember attending an anniversary of one of the oldest scientific societies on the

Continent. The celebration occupied three entire days; the scientific meetings almost four hours. May we not claim it as a merit to thus maintain a higher standard for national scientific meetings than we find in other countries?

Another important contribution of our Society was the introduction of winter meetings. We were the first, I think, to use the Christmas vacation regularly for this purpose. Now many societies use it and experience has shown that it is the best time in the whole year, under American conditions, for the holding of national meetings. It is, therefore, from our example that the demand for the establishment of Convocation Week arose.

The fourth achievement is the introduction of discussions of broader scope in which topics of common interest to those in allied branches of science are debated by high authorities. Such discussions do much to broaden our views and increase our appreciation of the solidarity of all science.

Now as to our future. I have already expressed my conviction that we should resign our function as the central body of affiliation in favor of the American Association, which, being so much larger, and so much wider in its scope, can undertake this work of affiliation on a larger scale and therefore more efficiently. The Association has adopted our plan of meeting during the Christmas holidays so that the substitution will be easy. It seems to those of us who have been interested in these plans that it will be of great value to the science of the country to have from time to time a great gathering, so great that its mere magnitude will impress the public and impress our public authorities. Science has yet to make in this country enormous demands from the public for support before it will attain the proportions which are indispensable for the maintenance of the national welfare. It is a duty, therefore, both to science and to the country, for every scientific man to contribute what he can to make known the needs of science. We depend wholly upon the dissemination of such knowledge for our resources, whether we get them from generous private individuals or by State or national legislation. But it must be remembered further that though affiliation is valuable, bringing together great numbers at one place is not always the wisest plan. Therefore it is necessary that every affiliated society should preserve absolute freedom and that it should be understood between the Society and the Association that the former may meet with the Association or not, as may be deemed expedient each time by the Society. There should be no compulsion from the Association, and I think it will often happen that one or several societies will find it advantageous to meet apart. The only absolute obligation which the affiliated societies ought to assume is the election of one or more delegates to represent the Society upon the Council of the American Association. It is hoped that by this means the Council will become, so to speak, a national senate representing the scientific interests of the country, and representing them very fully. Such a senate will have great influence and may exert its influence from time to time to the advantage of the country. It can speak with authority in regard to problems of legislation, of education and of scientific organization. It might make effective protests, as, for instance, against the outrageous system of duties upon scientific apparatus by which all our work is now impeded; or against the public clamor recently made in one of our States for the reduction of the income of the State University; or against the abuses of arbitrary and ignorant authority at some of our universities, of which we have heard during the last year.

If we resign this part of our work to the American Association, will there remain enough for us to do to make the perpetuation of our Society desirable? I think clearly, Yes. Even if we could do only what we are now doing—viz., keep up our annual discussion, our dinner and our presidential address—I should say we had in these purposes justification for our continued life. But I believe that we can take up a new task of affiliation which will solve one of the problems which we must solve. It is not enough to have great national meetings. We need besides less formal and more local meetings. The great distances in our country render this important. I should like, therefore, to suggest for your consideration an entirely new plan, viz., that of forming a series of local organizations or branches of our Society. There might be one such organization for example for New England, another for New York, a third for the Middle Atlantic States, a fourth for the Central States and a fifth for the Pacific coast. Each one of these branches could hold meetings for the presentation of scientific papers and invite to the meetings all the local members of the societies now affiliated with us. These meetings might last one or two days and could be held at a time of year when they would not in any way compete with the larger national meetings during Convocation Week. In that way the freedom of the individual societies affiliated with ourselves will be in no wise affected. Competition between ourselves and the American Association will be entirely avoided and the demand, which is real, earnest and well founded, for local meetings, will be answered. It would, moreover, contribute usefully towards the general organization of science throughout the country. That organization I believe to be of the greatest importance. If we look back on the history of science in this country we should probably all agree that the most important step ever taken to promote it has been the establishment of what are commonly called post-graduate courses at our principal universities; because these courses offer varied and excellent opportunities to train young men seeking discipline in science in order to become scientific investigators. But may we not say that to form a wide-reaching organization of science, national in extent and power, is a yet more important step destined to rank among the great achievements of the century upon which we are just entering? We have learned from our political organizations that numerous independent states and a central government work harmoniously and increase by their cooperation and power the welfare of all. So in our organization of science let us profit by this political example, and though we favor the organization and the strengthening of the central power, let us never forget that every body of men which joins in the organization must also be free. If we make 'freedom and affiliation' our watchwords, we shall escape many perils and conquer success.*

Charles Sedgwick Minot.

I shall speak to the following motion: Resolved, that the American Society of Naturalists authorizes the naturalists of the Central and Western States to organize a branch of that Society to meet at Chicago. That a committee of three be appointed by the president to arrange the details of the relation of the Eastern and Chicago branches and to provide for a joint meeting of the two branches at intervals of two or three years alternately in eastern and central territory. I shall not take time to argue the importance of annual meetings

* The original address was delivered from brief notes, with no thought of publication. In writing the article I found it impossible to recall the original discourse accurately, but I think the substance of it is unchanged except that certain parts of momentary or local interest have been omitted. C. S. M.

of naturalists. I shall not try to show how they aid in the development of science. All of us are willing for the love of research to work ten to fifteen hours a day; but it is the coming meeting at which we have announced a paper that stimulates us to work all night. Furthermore, as scientific men have no longer time to read, if it were not for this annual treatment of fifty doses of papers taken in fifty quarter hours we should be more ignoramuses than savants. I assume, therefore, that it is agreed that naturalists should get together once a year.

The question is: How inclusive should these meetings be? Some naturalists, even of the Mississippi Valley, urge that all of the naturalists of the country should meet together every winter. That is not practicable. As evidence it is only necessary to point out that if it were possible it would have happened already. As a matter of fact, the proportion of naturalists from the Central States attending the meetings of the American Society has always been small. At the present meeting, despite the most cordial interest of the eastern naturalists, we are all regretting the absence of many of our eastern friends and colleagues. Again, the experience of the American Association for the Advancement of Science proves that the great majority of the naturalists of one section of the country will not exceed a certain limit of time and expense to attend meetings in another section. At the Boston meeting of the Association 666 members, or about 74 per cent. of those in attendance, were from the Middle and New England States. At Denver, with great attractions for a summer meeting, there were 82 such members in attendance, or 27 per cent. of all attending. From the nature of the case you can't draw definite limits of distance and expense for the regular attendance of naturalists on meetings. But experience indicates that most naturalists will not travel regularly more than for about fifteen hours to attend a meeting, nor spend more than fifty dollars. In other words, an institution that will regularly send a majority of its naturalists to a meeting must be within 500 miles of the place of meeting. These facts teach that it is futile to hope that all naturalists of this country will meet regularly together; or even that those east of the Rocky mountains will do so.

A second proposition is that the Naturalists' meeting should be held in successive years in different sections of the country to meet the needs of the naturalists located in those sections. Thus, it might meet successively in New York, Chicago, Denver and San Francisco.

The objections to this plan are too obvious to require debate. It does away with the precious opportunity of an annual meeting of the naturalists of any one section of the country. Local societies would spring up to fill the need and the American Society would be sapped of its strength by them. The advancement of science demands that naturalists gather at least once a year.

A third proposition was made by a committee of the American Society of Naturalists at its last meeting. It is that the name 'American Society' should be abandoned. That the eastern society should reassume the name of 'Society of Naturalists of the Eastern United States,' with which it started. That the naturalists of the Central States might then form an independent and coordinate society. This plan would be a good one, perhaps, if the central and eastern sections were sharply marked off from each other or were politically distinct as, thank God, they are not. The Boston naturalist of this year will very likely be located in Chicago next year and the Michigan naturalist of a decade ago is a scientific leader in New York to-day. We change houses with facility, but we do not change the flag to which we owe allegiance and we don't want to change more than possible our scientific comradeship. We of the Mississippi Valley, if called east at Christmas time, would like to be able to attend the eastern meeting of naturalists as rightful members; and if any eastern naturalist (pro tempore) were in Chicago or vicinity at the time of our meeting, it would give us pleasure to realize that it would be his meeting also. We don't want to have the naturalists of the country artificially separated by geographical boundaries.

The fourth proposition is based on the national political principle. It suggests the organization of local, self-governing branches bound together by a central organization. For the present two of these branches seem necessary—one meeting in the east; the other at Chicago. It is proposed, further, that the two branches should meet together every third year, that is, once in six years we in the west will go east, and once in six years the east will come to the west. We should all try to attend these joint meetings, thus to renew old acquaintances and to make new ones. It may, however, appear better to try to meet together every other year; I trust we shall have a discussion of that point.

I have assumed above that the central naturalists will meet in Chicago. This is a local matter, but I take this occasion to refer to the fact that if we draw a circle of 500 miles radius, having Chicago as a center, it includes 99 per cent. of the naturalists who have met here in the past and it is generally agreed, I think, that no other point in the Central States would be so convenient to so many.

The plan here proposed has been opposed on the ground that it means disunion and tends towards the breaking up of the American Society. Precisely the opposite will be the effect. By this plan some hundred or more naturalists of high rank in the Central States will be added at once to the membership of the Central Society which will then become truly an *American* Society of Naturalists. At the same time that *continuity* of work that depends on a regular attendance of members will be gained.

C. B. Davenport.
University of Chicago.

In viewing the relations of American scientific societies in general, and of the American Society of Naturalists in particular, it is needful to occupy some platform; and since the limitations of time will permit no more than a hasty glance, a platform of two planks may suffice. The first of these has to do with the rate of progress of American science, and the second is connected with the trend of this progress; for it is not to be forgotten that while the maker of things moving begins with direction and proceeds toward rate, the interpreter of natural movement begins with rate and then proceeds to ascertain trend or direction—nor is it to be forgotten that the study of institutions is still in the interpretative stage. So the first plank may be defined as Advancement, while the second may be called Coordination.

To one in the thick of the turmoil it is not easy to keep note of the tremendous rate of scientific progress in America during recent years; for no adequate units of measure of intellectual activity and attainment have yet been devised. A suggestion may be found in the development of university facilities, since our universities partly lead and partly reflect our progress in science. Without tabulating the statistics in detail, it would seem safe to say that during the first half of the nineteenth century—*i. e.*, from 1800 to 1850—the university facilities of the United States were doubled; that during the next quarter-century, from 1850 to 1875 (despite the shock of the Civil War—perhaps partly by reason of it) they were doubled again; that from 1875 to 1890 they were once more doubled; and that during the last decade of the old century the doubling was again repeated, so that the nineteenth century went out with at least sixteen times the university facilities (including endowments, etc.) of her incoming. Nor is this the end; for present indications are that our university wealth will double again within the first five years of the new century. Even this is not all; for the fin de siècle university is scientific —an institution for research into the unknown as well as for the preservation of the known—in far larger degree than was the university of 1800. So the university mete shows that American science is advancing in a geometric ratio, an increasing rate in which the rate of increase is still increasing with increasing rapidity. Any other measure gives similar results: Reckoning what may be called state science in terms of appropriations for its maintenance, the growth, from Olmsted's Geological Survey of North Carolina, beginning in 1823 at $250 per year, to our present two-score of state surveys and related institutions, has been even more vigorous than that of our universities; while our direct federal appropriations for scientific work, beginning with a few hundreds in 1811, passing the million mark about 1870, and now rising above ten millions annually, give eloquent testimony of national advance in knowledge-making at an ever-increasing rate. A still more striking measure is afforded by the growth of our scientific societies—or will be when the statistics are tabulated. Yet all these measures, impressive though they be, are little more than symptoms attending the permeation of a healthful serum throughout the body of American citizens; for our average citizen, whose ancestors in 1800 planted potatoes in the dark of the moon and sniffed witchcraft and black art afar, is now a devotee of the methods of science as well as of rational interpretations of nature, and looks to the Agricultural Department or the Smithsonian Institution or the neighboring university for standards of practical thought—even if he half complies against his will, and is half of old opinion still. It is a hopeful sign of the times that American science, measured by any standards, is advancing more rapidly than our fast-growing population or quick-increasing national wealth—that it is indeed drifting into its true place in the lead of our industrial development. Such is the Advancement of American science.

Turning now to Coordination: The advance of science is largely—indeed wholly, in the last analysis—dependent on social development; and the law of social development is integration. The ways along which integration proceeds are many: The growth of the family into the clan and of the clan into the tribe, and the union of tribes into confederacies, with the ultimate welding of these into nations, all represent a process of integration peculiarly instructive to students of institutions, scientific and other; the steady breaking down of racial barriers, the world-wide blending of blood and culture, the merging of laws and languages, and the diffusion of cults (whether of faith or of works) according to their fittingness for the several stages of intellectual development, all represent ways of social integration—ways whose name is legion, and whose ramifications and osculations it were needless now to follow. Yet he who would fairly view the growth and relations of our voluntary associations for scientific research can not afford to neglect the analogy of primitive society in its growth from clan to tribe, and thence on and upward along the noble course of intellectual strengthening and human betterment. Now the germ of the clan is a family bound by ties of common interest; and its analogue in scientific organization is the group of kindred spirits working to a common end, like the half-dozen geologists who later formed the American Society of Geologists, the precursor of the American Association for the Advancement of Science. The clan itself is an enlarged family, comparable to the same half-dozen geologists and their fellows when the magnet of knowledge-making drew them into the closer union of definite organization; while the tribe may be likened to the permanent association defined and bound by articles and constitutions and by-laws. The likeness between the primitive tribe and the society of specialists is much more than a fanciful parallel—indeed the analogies are many and close, too many for counting and too close for discussing in brief space; it must suffice to accept the analogy and pass to the application. The significant point is that the tribe, after reaching a certain (*i. e.*, uncertain) magnitude, either multiplies by fission (breaks down beneath its own weight, in other words) and so forms subtribes which are eventually confederated on the basis of higher laws, or else passes directly into more or less definite confederation with alien tribes. It is no less significant that the confederated tribes long retain their integrity, just as do the component clans in many instances and the constituent families in all; so that the confederacy becomes a sort of hierarchy of interdependent groups, presaging the interdependent townships, counties, wards, municipalities, judicial districts, representative districts, States, and other collective units of enlightened society. Now accepting the analogy between the tribe and the voluntary scientific association, the application is simple; the association may either multiply itself by fission (*e. g.*, into sections), or in some other way prepare for reorganization on a more comprehensive plan; yet the broader organization need not interfere with the original affinities and affiliations, any more than the Seneka Indian was made less a Seneka by the Iroquois confederation, or the citizen of Chicago is less a Chicagoan because he is a native of Illinois and a citizen of the United States—as well as a Mason, a Presbyterian, and a free-trade Republican. The plank of social integration is too broad and too long for easy trimming into a three-minute platform; but fortunately it tells half the story in itself.

Such are the great fact and the fundamental principle to be borne in mind in our search for the best way of future progress for the American Society of Naturalists—the fact of unparalleled Advancement, and the principle of institutional Coordination.

The Society of Naturalists is conspicuous among American scientific societies in many ways, notably for its habitual exaltation of the scientific spirit above the letter of organic law and hence for unprecedentedly rapid and vigorous growth—indeed this Society, more than any other, may be regarded as the type and expression of modern scientific activity in America. Founded primarily to meet the needs of serious students of science, incidentally as a foil if not an antidote for the peripatetic pleasuring and jocose junketing charged against an older organization, it has kept even pace with the tremendous scientific progress of the last two decades, and has become a leading power in guiding scientific thought and shaping scientific policy. Naturally, in view of its phenomenal growth, it reveals signs of that fission whereby all social institutions prepare for reintegration on a higher plane. True, the laxity of the law is such that the original organization is not unduly constrained; yet, as a nucleus for a group of affiliated societies, its vitality is diffused to the benefit of the group rather than concentrated in the sole interest of the unit. The career of the Society from 1883 up to the present seems to have been normal, fully in accord with the times, and beyond reproach; its present function as a nucleus for special societies—*i. e.*, subtribes, in the analogy with primitive socialry—would also seem to be ideal; yet the question arises, May not the naturalists assume a larger rôle on the stage of American science? And this in turn evokes another: If so, how?

In seeking answers to these queries, the mind turns at once to broader affiliations and stronger affinities than those already developed within the Society of Naturalists; and among the first of the possible affines, thought rests on the American Association for the Advancement of Science, that older organization of which the younger body is, in some measure, the reciprocal if not the antithesis. It is to be remembered that the Association, also, has reached the stage of fission, or of reintegration on a higher plane, the stage being marked partly by increasing autonomy of the component sections, partly by the affiliation of several special societies, each a power in its specialty and all an immeasurable force in shaping the science of a nation. Originally an agency of diffusion and direct advancement combined, the Association for a time was mainly devoted to the former function; of late, thanks largely to the influence of the affiliated societies, it seems to be resuming the original function of direct advancement through its own activity and through fostering kindred societies, so that its present aims are so nearly akin to those of the Naturalists that the two organizations might well cooperate, or even confederate, for mutual advantage and the common benefit of American science. The possible modes of cooperation, and the possible lines of confederation, are too many for present discussion; but it may be held, in the light of analogy with primitive socialry as in that of current experience, that neither cooperation nor confederation need involve loss of autonomy, or efficiency, or dignity, on the part of either organization.

Out of the many possible lines of action leading to coalition between the two most vigorous and virile of our voluntary scientific societies, one or two may be urged: The American Association for the Advancement of Science has already decided to hold a winter meeting in Washington during the Convocation Week of 1902–3, and it has just been decided by this body to hold its annual meeting at the same time and place. Now it is suggested that the American Society of Naturalists take the requisite steps toward admitting representatives of the Association to its Council, and toward securing representation in the Council of the Association, preferably at this approaching meeting, and if not then, at the earliest possible occasion; it is also suggested that this Society take early steps toward enlarging and strengthening its Council in such manner that the administrative bodies of the two organizations may attain parity of power. It need hardly be said that the joint meeting would serve, and better serve, every purpose of separate meetings; and it need hardly be added that one effect of the joint meeting would be to increase common membership in the two organizations, and thus to strengthen the already strong bonds of common interest.

In another place* it was pointed out that a need of American science to-day is a delegate organization—a Senate of Science—in which our many and constantly multiplying local and special voluntary associations of scientific men might be equitably represented in a body not too large and unwieldy for effective work in coordinating lines of research and keeping in touch with national progress; and it was suggested

* SCIENCE, N. S., Vol. XIV., 1901, pp. 277–280.

that the Council of the American Association might well serve as the nucleus for such an organization. To-day a still more promising nucleus for a national scientific organization of unprecedented dignity and power may be glimpsed through eyes of hope; for it is within bounds to anticipate joint meetings of the Councils of America's two representative organizations of science, and joint action with all the strength of union, at no distant day.

W J McGee.

Bureau of American Ethnology.

It is not long since a gathering as representative of American science as the present one would have been a very different kind of audience. It would have been much smaller, without men enough specially representative of any one branch of knowledge to warrant them in meeting together as a section, but composed of men practically all of whom would have heard with interest and discussed with intelligence any paper on the program.

Recent years have brought about a marked change in science as in other things. Material prosperity has made it possible for more men than formerly to devote themselves to the acquisition and diffusion of learning, and the means and appliances at their hand have increased to no less a degree. With this has come, as a means to the performance of the more difficult tasks of research, specialization and attendant division of labor, so that the scientific organizations are now commonly not only larger, but far more complex, and one often goes away from a meeting with something like an intellectual dyspepsia, induced by the many and extremely varied courses offered on the program.

In another important respect conditions have greatly changed. The time was when the great distances lay beyond the workers in science. To-day, because of the development of the whole country, they lie between the workers, not equally, but in such a manner as to cause a concentrated eastern and a more scattered western population. Though distances are now traveled in hours that formerly required days, the expenditure of time and money involved in passing these great distances is so great as to seriously interfere with the holding of truly national meetings, and I desire to express my full appreciation of the action of this society in setting aside a geographic restriction of its constitution in order that this most successful meeting might be held in Chicago. Shortly before leaving home I received a letter from a friend, in which regret was expressed that the eastern botanists who commonly meet in conjunction with this Society had not felt it wise to set aside a like provision of their own constitution, so that they are now meeting in the east, and adding that, much as would be gained by meeting with the affiliated societies now in session here, it did not seem quite right to depart from their custom and so deprive the younger men, not blessed with a superabundance of this world's goods, of a meeting that they desired and were entitled to, but for which they could not travel far.

In our childhood we all learned the fable of the man who one day brought in an armful of twigs, and, handing them one after another to his son, asked him to break them, which was readily done; but when a like number were closely bound together into a bunch, they could not be broken nor even greatly bent. I believe it was the schoolmaster who first made practical use of this particular demonstration of the strength that lies in union, but before my own time he had abandoned it because of the greater flexibility of the unit. Business men have recently begun to make much and profitable application of the principle, and as, in manufacture and traffic, material results are quickly available for the testing of changes in organization and management, they are rapidly securing both strength and economy and efficiency of administration, by combination. If the century just closed is likely to stand out prominently in history as that marked by specialization and differentiation, that on which we have just entered appears likely to take place as that in which rational union, coordination and centralized organization form prominent features; and this is likely to be as true of the machinery of instruction and of research as it is of business combinations.

Professor Minot has very thoughtfully and logically presented the bearing of this line of thought on this society and the affiliated organizations. Difficulties may be experienced at first in perfecting the details of the most useful and workable organization, but they are likely to be seen and overcome, and I have little doubt that the great Washington meeting that we are all hoping to attend next winter will initiate a federation of scientific interests that, without losing in productiveness, will gain an almost irresistible strength which will be productive of great good in many ways.

But in this centralization of interests those who can not travel great distances to attend the general meetings should not be forgotten. I feel that while none of us who can attend the great meetings can afford to miss them, those who can not go to them should be given every help and encouragement in holding meetings at places convenient to their homes. I have assumed that your committee, in inviting me to take part in this discussion, did so because they wished the point of view of the central botanists represented. On this assumption I have tried as far as possible to ascertain the feeling of those botanists, and I think I may say without impropriety that the botanists now meeting in connection with this Society feel the need of a local organization, and have taken steps toward its formation, though, in view of the discussion to be held this afternoon, possible action by this Society this evening, and the announcement of a general meeting of the central naturalists called for to-morrow morning, for the consideration of the same question, they have deferred their final action until to-morrow. Whatever they may believe desirable for the furtherance of their more immediate interests, I am confident that their support may be counted on for all wise concentration, and that at all times, those who are able and free to attend the general meetings may be counted on to do so, while those who must stay nearer home will prove willing to act in unison with the central body on all matters of scientific importance where concerted action is needed, while they anticipate no refusal of the full power of the general organization in any matter concerning which it is proper for them to ask support.

William Trelease.
Missouri Botanical Gardens.

There are evidently two subjects under consideration by the Society, and these are only indirectly related. One is the subject of cooperation, affiliation, or more organic union between the American Society of Naturalists and the American Association for the Advancement of Science; and the other is the organization of local branches of the Society of Naturalists, or sectional societies having a similar field and affiliated with that general organization.

Assuming that the time of meeting of the American Association is to be changed to Convocation Week, there seems to be a practically unanimous judgment favorable to a meeting of that society and the Society of Naturalists at the same time and place, and to a close coordination or affiliation of the work of these societies. I can see how certain practical difficulties would arise from the meeting at the same time and place of two societies or groups of societies so largely similar in character and scope—meetings of the Botanical Section of the American Association, and of the Society of Plant Morphologists affiliated with the Naturalists' Society; meetings of the Zoological Section of the American Association, and of the Society of American Morphologists; and so on—but I presume that these matters have all been considered and that means of adjustment will readily be found. As to the soundness of the idea, I cannot see that there need be any doubt.

With respect to the formation of a local society in the central states, to be affiliated in some way with the group of societies in session here at this time, I think the only subject upon which difference of judgment might possibly arise is that of the method of the affiliation. It seems to me that in the nature of the case we shall finally be forced to form sectional societies in most of the branches of science represented by the existing organizations. As the scientific population of the country becomes more equally dispersed over its whole area, we find this area too large to permit general annual meetings of those most interested and most likely to profit by them. The distances are so great as practically to prohibit attendance upon the part of many members, and the number presenting papers in each society or subdivision is such as to crowd the programs unduly, diminishing the interest and value of the meetings. We need a satisfactory geographical unit of assemblage for scientific meetings, one not so large as to make attendance a burden upon those living on the outskirts, and yet large enough to permit a satisfactory subdivision of the programs of societies into sections corresponding to the subdivisions of the subject matter. From what we have seen during the last two years and at the present meeting, it seems to me quite clear that the states of the Mississippi Valley—now coming to be known as the Central States of the Union—should form one such unit of assemblage. Indeed a society of naturalists has already been formed for this area, and has had two highly successful meetings, definite organization having been delayed merely with a view to the issues of this meeting. Probably other such sectional societies might be organized to advantage (if not now, before many years), all to be associated as divisions of a more general organization for the country as a whole.

On the supposition that such a society is now to be organized here, the subject of its relations to existing societies will come up for settlement. In this connection it is helpful to notice the difference in organization of the Society of Naturalists and that of the American Association for the Advancement of Science. In the former there is one general society which serves as a bond of union for special societies, each independent in organization and management, but associated by affiliation with the general body, the latter being scarcely more than an administrative convenience. In the American Society for the Advancement of Science, on the other hand, there is a more compact general society, with subdivisions, called sections, formed mainly for program purposes. In the American Society of Naturalists we have had, thus far, no sections in the latter sense, but only affiliated societies, and I am inclined to think that this method of organization should be continued as local societies spring up in response to local requirements. I would rather, in short, see the naturalists of the Central States organized under the form of an independent but affiliated body than in the form of a section of the national society.

I doubt also the advisability of attempting to fix in advance the place of meeting of the proposed new society or section or to determine unnecessarily any detail of its policy by a resolution passed by this body at this time. If its members should prefer peripatetic meetings to those held at one fixed point, I think it should be possible for them so to determine, especially as that is now the policy of the whole group of societies associated in this organization.

I am obliged to you, Mr. Chairman, for the opportunity to participate in this discussion, which I owe to your courtesy only; and I have spoken merely on a few points which have occurred to me as I listened to those who have preceded me.

S. A. FORBES.
UNIVERSITY OF ILLINOIS.

'A HAND apart from the rest of the body is not a hand,' said Aristotle, and modern psychology shows that each of us exists only in his relations to others. Writing and the printing-press have made science possible by permitting intercourse between those separated in time and space, but they have not done away with the necessity for personal contact. Correspondence schools can not replace universities, nor do journals and books make needless the coming together of scientific men. The organization of academies and societies has been an essential factor in the development of modern science. Two or three hundred years ago the men of a neighborhood began to meet to discuss scientific questions. Fifty to a hundred years ago, when railways made it possible, national associations were established. As the sciences became differentiated, the academies and associations met in sections, and special societies were established in each country for different sciences. These societies or their members now meet occasionally in international congresses.

We have indeed at present a somewhat bewildering array of scientific societies which have arisen in answer to special needs. It is time that the methods of science should be applied to their proper coordination. The two closest bonds of union are common interest in a subject and local proximity. We have, as a matter of fact, national societies for nearly every science, and local academies in nearly all our larger centers. When there are enough students of the same subject in the same place we have the natural unit; these groups should unite on the one hand to form the local academy, and on the other hand to form the national society. The national societies should be parts of a great national association. The presentation and discussion of research belong to the special societies; the coordination of the work of different sciences, legislation on behalf of science as a whole, and the representation of science before the intelligent public, belong to the national association. For the transaction of business, this association can no longer be a plebiscite, but must be a house of delegates representing the scientific interests of the country.

The American Society of Naturalists, with which we are at present more especially concerned, represents certain sciences and a certain region; it does not form an integral part of what appears to be the trend of scientific organization. Historically our society has performed a service of immense value. In the limitation of participation in its work to scientific men, in delegating special papers to special societies affiliated with it, in its discussions of questions of general scientific interest, and in its choice of midwinter as a time of meeting, it has set an example to the American Association. In recent years, however, the American Association has maintained the same scientific standard, and we have practically one group of scientific societies meeting in midsummer and another in midwinter. The greater power of a general association is indicated by the fact that all the societies meet in summer under the auspices of the American Association, whereas at present the national societies are meeting not only here in Chicago, but also in New York, Philadelphia, Rochester and Washington. The greater influence of a national association is again shown by the fact that it has been able to secure from our universities and colleges a special convocation week in midwinter. This could not have been accomplished by our Society representing only certain sciences and a certain region.

Hereafter the chief meeting of the American Association will probably be held in convocation week, and the national societies devoted to special sciences will probably meet with it. Our views as to the future functions of the Society of Naturalists depend on how we answer two questions. Should our special scientific societies be national or sectional? Should they meet at the same time and place? To me it seems that the special societies should surely be national, or American, with local sections. A national society for each science will ultimately be essential for purposes of publication and for legislative functions. An annual or occasional meeting of those engaged in the same kind of work is of the utmost importance—scientifically, professionally and socially—and should be maintained in spite of the sacrifices of time and money imposed by the large area of our country. It seems to me further that our national societies should meet together. It is economical to make local, railway and other arrangements, once for all. Most of us belong to more than one society and like to meet friends following different lines of scientific work. Indeed, sharp lines can not be drawn between the sciences; we have astrophysicists, electrochemists, general biologists, physiological psychologists, and the like, who would be divided by separate meetings. There are judicial, legislative and executive functions, in which all men of science should unite, and for their accomplishment a general meeting is essential. Then, lastly, the weight of science is impressed on the general public only by a meeting of sufficient magnitude.

The limits of a thousand words do not permit an attempt to emphasize the importance of national scientific societies and of a general congress of scientific men, and after all the logic of events is the strongest argument. We *have* national scientific societies, and they *do* meet in groups—nearly all the sciences in the summer, with the American Association, and the biological sciences in the winter, with the Society of Naturalists. The meetings of the American Association have, it is true, been interfered with by summer holidays, summer heat and the winter meetings; and the winter meetings of the American Society of Naturalists are threatened with a local division. It seems reasonable, however, to assume that next year, at least, all our societies will meet together at Washington in convocation week.

Supposing there to be a general annual meeting, say once in three years at Washington, once in the eastern states and once in the central or western states, what should be the function of the Society of Naturalists? It seems that the general arrangements should be left with the American Association, covering all the sciences and the whole country, and having permanent and salaried officers. Our society might hold separate meetings in the east when the national societies meet in the west. I myself, however, regard this as undesirable. Should the Society of Naturalists then be disbanded, having accomplished its work? I think not. There is place for a compact organization within the American Association representing certain sciences and a certain region. The original objects of the Society—the organization of scientific work, the teaching of science, the conduct of museums and the like—still need an organization. Our discussion, our public lecture and our dinner with a presidential address should not lightly be abandoned. Within the Royal Society and the British Association there have been clubs, primarily social, but exerting great influence on the policy of the larger organizations. The National Academy performs valuable functions as a select association composed of some of our more eminent scientific men, and the Society of Naturalists, composed of some of our more efficient and public-spirited students of the natural sciences in the eastern states can accomplish much, in the future as in the past, for the advancement of science. J. MCKEEN CATTELL.

COLUMBIA UNIVERSITY.

THE ASTRONOMICAL AND ASTROPHYSICAL SOCIETY OF AMERICA.

I.

THE first winter meeting of this Society was held at the Cosmos Club, Washington, D. C., Monday, Tuesday and Wednesday of Convocation Week. Sessions for the reading of papers were held both morning and afternoon, on Monday and Tuesday, and on Wednesday morning. The maximum attendance of about fifty was reached on Tuesday.

Twenty-eight new members were elected, and it was decided to hold the next meeting of the Society at Washington during Convocation Week, 1902–3.

A number of the members lunched together both on Monday and Tuesday at Barton's, and on Monday evening attended a dinner at the same place. The president of the Society presided, and among the most delightful features were the after-dinner speeches of Professor W. W. Campbell, Professor George E. Hale and Professor S. I. Bailey. If a similar function is held at the next meeting it is hoped that the ladies of the Society will more generally follow the example of the two present at this time.

On Tuesday evening President and Mrs. Newcomb received the members of the Society and numerous invited guests at a conversazione held at the Arlington Hotel. During the evening papers illustrated by stereopticon were read by Mr. Percival Lowell on Mars, by Professor S. P. Langley on personal equation and the infra-red spectrum, by Professor George E. Hale on a comparison of the results obtained by photography from the forty-inch refractor and the two-foot reflector of the Yerkes Observatory, and by Professor W. W. Campbell on the work of the Lick Observatory eclipse party in Sumatra and the nebula surrounding Nova Persei.

After the reading of these papers the guests were invited into an adjoining room to partake of still another astronomical treat and refreshments. Here the room was fitted up with numerous transparencies and photographs from the Harvard College Observatory, from the Yerkes Observatory, from the Lick Observatory and from the United States Naval Observatory.

On Tuesday a number of the members visited the Astrophysical Observatory of the Smithsonian Institution upon a special invitation to the Society from Secretary Langley.

At the adjournment of the Wednesday morning session the members formed in line, marched to the White House and paid their respects to President Roosevelt, special arrangements having been made for their reception.

OFFICERS ELECTED.

For 1902: *President,* Simon Newcomb; *1st Vice-President,* George E. Hale; *2d Vice-Presi-*

dent, W. W. Campbell; *Treasurer,* C. L. Doolittle.

For 1902–3: *Councilor,* E. C. Pickering; *Councilor,* R. S. Woodward.

Holdovers: *Secretary,* George C. Comstock; *Councilor,* S. J. Brown; *Councilor,* Ormond Stone.

RESOLUTIONS ADOPTED.

Resolved, That the members of the Astronomical and Astrophysical Society in attendance at this meeting hereby tender their cordial thanks to the Board of Management of and to the members of the Cosmos Club for the use of the Club, Assembly and Council rooms, for the excellent facilities afforded for the illustration and exposition of the papers presented at this meeting, and for the kindly social courtesies extended to all members of our Society.

Resolved, That the thanks of this Society be tendered to Professor S. P. Langley for the special opportunity afforded by him to visit the Astrophysical Observatory of the Smithsonian Institution.

Resolved, That the thanks of the Astronomical and Astrophysical Society be tendered to the Philosophical Society and to its treasurer, Mr. Bernard R. Green, for the use of apparatus and courtesies shown during the present meeting of the Astronomical and Astrophysical Society.

Resolved, That the Secretary of the Society be requested to transmit the substance of these resolutions to the Board of Management of the Cosmos Club, to Professor S. P. Langley and to the officers of the Philosophical Society respectively.

Resolved, That the members of the Society in attendance hereby express their cordial appreciation of the active services of the President in perfecting all arrangements for this meeting and in providing so amply for social as well as for astronomical and astrophysical entertainment.

PAPERS PRESENTED.

1. 'The Flash Spectrum, May 18, 1901': S. A. Mitchell. [Read by J. K. Rees.]

2. 'Lick Observatory-Crocker Expedition to Sumatra to observe the Total Solar Eclipse of May, 1901': C. D. Perrine. [Read by W. W. Campbell.]

3. 'U. S. Naval Observatory Eclipse Expedition to Sumatra': A. N. Skinner.

4. 'Astronomical Photography with the Forty-inch Refractor and the Two-foot Reflector of the Yerkes Observatory': G. W. Ritchey. [Read by G. E. Hale.]

5. 'On the Phenomenon called Signals from Mars': Percival Lowell.

6. 'Preliminary Statement of Results of International Magnetic Observations during the Total Solar Eclipse, May, 1901': L. A. Bauer.

7. 'Meridian Circle Positions of Nova Persei': R. H. Tucker. [Read by W. W. Campbell.]

8. 'Note on the Parallax of Nova Persei': F. L. Chase.

9. 'Note on the Parallax of Nova Persei': R. G. Aitkin. [Read by W. W. Campbell.]

10. 'The Energy of Condensation of Stellar Bodies': R. S. Woodward.

11. 'Optical Distortion of Photographic Telescopes': Harold Jacoby.

12. 'The Constant of Aberration': C. L. Doolittle.

13. 'The Period of Delta Equulei': W. J. Hussey. [Read by W. W. Campbell.]

14. 'Duration of Twilight at Different Altitudes within the Tropics': S. I. Bailey.

15. 'The Determination of Double Star Orbits': George C. Comstock.

16. 'A Cosmic Cycle': F. W. Very.

17. 'A Comparison of Printing and Recording Chronographs': C. S. Howe.

18. 'The Clock Room at Case Observatory': C. S. Howe.

19. 'The Almucanter as an Instrument for the Determination of Time': C. S. Howe.

20. 'A Description of the Second (Chile) Mills Spectrograph': W. W. Campbell.

21. 'The Capture of Comets by Jupiter': Percival Lowell.

22. 'The Latitude-Variation Observatory of the International Geodetic Association': H. S. Davis.

23. 'Some Vices and Devices in Astronomical Computations': H. S. Davis.

24. 'On the Pressure of Light and Heat Radiation': E. F. Nichols.

25. 'The Mass of Titan and its Perturbations of Hyperion': W. S. Eichelberger.

26. 'Observations of November Meteors': C. A. Post and J. K. Rees.

27. 'A Kinematic Study of Hansen's Ideal Coordinates': K. Laves. (Read by title only.)

28. 'The Computation of Laplace's Coefficients by means of Gyldén's γ Coefficients': K. Laves. (Read by title only.)

29. 'A Theorem Concerning the Method of Least Squares': Harold Jacoby. (Read by title only.)

30. 'The Nebula about Nova Persei': F. W. Very.

31. 'A Short and General Method of Determining Orbits from Three Observations': A. O. LEUSCHNER. [Read by O. Stone.]

32. 'Elements of Asteroid 1900 G A and Ephemeris for the Opposition of 1901-1902': A. O. LEUSCHNER and ADELAIDE M. HOBE. [Read by O. Stone.]

33. 'Discovery of Rapid Motion in the Faint Nebula Surrounding Nova Persei': C. D. PERRINE. [Read by W. W. Campbell.]

34. 'A Determination of the Wave Lengths of the More Prominent Nebular Lines': W. H. WRIGHT. [Read by W. W. Campbell.]

35. 'The Bruce Spectrograph of the Yerkes Observatory': E. B. FROST. [Read by G. E. Hale.]

36. 'A Remarkable Solar Disturbance': GEORGE E. HALE.

37. 'A Determination of the Cause of the Discrepancy between Measures of Spectrograms made with Violet to Left and Violet to Right': H. M. REESE. [Read by W. W. Campbell.]

38. 'Four New Spectroscopic Binaries with Notes on the General Subject': W. W. CAMPBELL.

39. 'Discovery of 500 Close Double Stars': W. J. HUSSEY. [Read by W. W. Campbell.]

40. 'Discovery of 300 New Double Stars': R. G. AITKIN. [Read by W. W. Campbell.]

ABSTRACTS OF PAPERS.

The Flash Spectrum, Sumatra Eclipse, May 18, 1901: S. A. MITCHELL.

The writer, through the courtesy of the director of the Naval Observatory, became a member of the expedition to view the Sumatra eclipse on May 18, 1901, and was stationed at Sawah Loento. Two instruments were employed, a camera of 104 inches focus to be used in connection with a cœlostat; and a spectroscope consisting of a Rowland flat grating of 15,000 lines having a ruled space of $3\frac{1}{2} \times 5$ inches, and a quartz lens of 3 23/64 inches aperture and 72 inches focal length. Light from the sun reflected by the cœlostat mirror in a horizontal direction, fell on the grating where it was diffracted, and was brought to a focus on the photographic plate by means of the quartz lens. If grating and photographic plate are each perpendicular to the diffracted beam, the spectrum is 'normal.' It was arranged to photograph the first order spectrum from λ 3,000 to λ 6,000.

The weather on the day of the eclipse was extremely disappointing. First contact was observed in a perfectly clear sky, but clouds soon began to gather and were so dense at second contact that the first flash was not observed at all. Toward the middle of totality conditions became a trifle better, so that it was possible to see, through clouds, the corona extending for about half a diameter from the sun. During no time of the 5 min. 41 sec. of totality was an unclouded view of the corona obtained, but nevertheless, the second flash was seen beautifully. Altogether eight exposures were made, one before and one just after totality for the cusp spectrum, one at first and one at second flash, and four with different lengths of exposure during the total phase. The second flash seemed fully exposed, and it is to a discussion of this photograph that this paper is devoted.

The peculiarities of this photograph are:

1. Normal spectrum.
2. Great dispersion.

On the plate the distance from F to H is 95.4 mm., and as the spectrum is normal, 1 mm., therefore, corresponds to a difference of wave-length of 9.37 tenth-meters, or 1 tenth-meter corresponds to a dispersion of about 0.1 mm. For some reason, the spectra were not in perfect focus, but in spite of this fact, in view of the great dispersion of the spectrum, measures were made and wave-lengths determined with a high degree of accuracy. The spectrum extends from λ 4,924 to λ 3,320, but the focus becomes poor beyond K, and measures were discontinued at λ 3,835. For the purposes of the present comparison, the region from F to H only was regarded. In this part of the spectrum 363 lines were measured in the flash. An arbitrary scale of intensities was assumed whereby 0 represents the faintest line seen with certainty, 10 the strongest line. Wave-lengths were compared with Rowland's measures of the solar spectrum. Of the 363 flash lines, 269 were identified with lines on Rowland's map. Although we cannot directly compare the intensities of the bright lines of the flash (scale 0–10), with those of the dark lines given in Rowland's tables (scale 1–1,000), we can arrive at certain theoretical considerations if we compare the average intensities for the different elements, *i. e.*, $\frac{\text{Flash intensities}}{\text{Solar intensities}}$, and also the ratios of the number of lines of each element identified to the whole number of solar lines for that metal. Forming these ratios and arranging them, we are at once struck with the systematic variations, not only in the ratio of intensities, but also in the per cent. of lines identified. The meaning of these systematic differences will be understood if we consider these ratios in combination with the atomic weights of the various elements, as in the following table, where also is put down the number of the lines in the flash due to each metal.

These lines naturally fall into three groups, as given in the table below.

To these may also be added the following lines:

La, atomic weight, 138.5............3 lines
Ba, " " 137 ....1 line
Ln, " " 65 ....1 line

In Group I. would also fall Al if we consider the relative intensities of the two lines λ 3,944.160 and λ 3,961.674; and undoubtedly Na if our plate took in the D lines. The remarkable variation of the relative intensities in the flash and Fraunhofer spectra, as Evershed has pointed out, is undoubtedly due to the *heights* to which the vapors of the different metals ascend in the chromosphere. A gas with an intrinsic brightness 1 and a layer 100 miles in thickness, would give a photographic line in the flash spectrum just as bright as a gas of intrinsic brightness 100 and only 1 mile

Group I.—Lines Strong in Flash and in Solar Spectrum.

Element.	Atomic Weight.	Number of Lines.	Intensity Flash. / Intensity Solar Lines.	Lines Identified. / Total Number of Lines.
Na	23.0			
Mg	24.3	1	0.10	1.00
Al	27.1			
Ca	40.0	8	0.34	0.38

Group II.—Lines Strong in Flash, Weak in Solar Spectrum.

Element.	Atomic Weight.	Number of Lines.	Intensity Flash. / Intensity Solar Lines.	Lines Identified. / Total Number of Lines.
Sc	44.1	6	0.86	0.75
Ti	48.1	62	0.67	0.70
V	51.2	15	0.49	0.68
Cr	52.1	38	0.56	0.64
Mn	55.1	27	0.25	0.48
Sr	87.6	2	1.08	0.67
Y	88.7	2	0.50	0.67
Zr	90.6	8	0.27	0.62

Group III.—Lines Weak in Flash, Strong in Solar Spectrum.

Element.	Atomic Weight.	Number of Lines.	Intensity Flash. / Intensity Solar Lines.	Lines Identified. / Total Number of Lines.
Fe	56.0	125	0.23	0.32
Ni	58.7	9	0.32	0.28
Co	59.0	6	0.19	0.29

thick, if the sun and moon were relatively at rest during the period of the 'flash'; but considering the gradual advance of the moon in covering successive layers of the sun's atmosphere, we see that in the emission spectrum the flash line of the fainter gas would be many times more intense than that of the brighter. The absorption lines of the two gases would be very nearly the same. The extent of the metallic vapors of the sun's surface probably varies inversely proportional to their atomic weights.

In consideration of these facts, it seems altogether likely that the gases of the metals of Group II. extend very high, and are nowhere very much condensed. The flash lines are to be regarded as true reversals of the corresponding solar lines. The metals of Groups I. and III. are somewhat denser near the sun's surface and do not extend so high as those of Group II., but as it is the upper portions that contribute most to the formation of the emission lines, the flash lines are to be regarded as only partial reversals of the Fraunhofer lines, the solar intensities being greater than the flash intensities. Most of the strongest lines in the solar spectrum have been found in the flash; and this, taken in connection with the meaning of the differences of intensities, leads us to further renew our faith in the existence of the 'reversing layer.'

The Total Solar Eclipse of May 18, 1901: C. D. PERRINE.

The expenses of an expedition to Padang, Sumatra, from the Lick Observatory, to secure observations of this eclipse, were defrayed by Mr. William H. Crocker, of San Francisco. Eclipse day dawned with light clouds covering the sky. But little change occurred during the morning. At the time of first contact, the sun shone through a rift in the clouds. At the beginning of totality all parts of the sky near the sun were covered with light cirrus clouds and haze. The inner corona only and Mercury and Venus could be seen during the early part of totality. The clouds became very much heavier towards the end of totality. The time of beginning and ending of totality was 3 or 4 seconds later than the time of these phases computed from data given in the *American Ephemeris,* but the uncertainty of longitudes in Sumatra may account for nearly if not all of this. Twelve photographs of varying exposures were secured with a camera of 40 feet focal length. These show the inner corona and prominences as well, probably, as if the sky had been free from clouds. The longest exposure, one of 150 seconds, shows the streamers to a distance of one and one-third diameters from the limb—more than could be seen with the unaided eye. A number of small prominences are visible on the east limb of the sun. One of these at position-angle 115° is covered with a series of coronal hoods or envelopes. Attention is called to a remarkable disturbance in the corona in the northeast quadrant. At a position-angle of about 65° there is a small compact prominence, over which there is a disturbed area resembling roughly an inverted cone. From the apparent apex of this area a number of irregular streamers and masses of matter radiate as if thrown out by an explosion. I am not aware that a disturbance of this kind has been observed before in the corona proper. Eight photographs were secured with the Floyd telescope of 70 inches focal length. These negatives show the same extensions of corona as those taken with the 40-foot camera. Twelve negatives were secured of six regions on either side of the sun in the direction of his equator for the purpose of detecting any planets existing there. These negatives were obtained with lenses of 3 inches aperture and 11 feet 4 inches focal length.* A preliminary examination of these negatives was made at the station and 92 stars of magnitude 8.6 to 8.8 were found in three of the regions. The plates taken during the latter part of totality show no star images, owing to the increased cloudiness. A negative with long exposure was secured with each of two spectrographs, one having the slit tangential, the other radial. The principal Fraunhofer lines are shown in the outer corona in both, none, however, being observable in the extreme inner corona. Ten negatives were secured with a camera of 21 inches focal length, having a double-image prism placed in front of the objective. The two images given by such a prism and camera furnish a means of detecting by differential methods any considerable polarization in the corona. The axis of the prism was set at several different position angles between the sun's equator and his poles. In this way all parts of the corona were tested. The negatives secured show a large percentage of polarization in the outer corona and a slight amount in the inner corona. The two spectrographs and the polarigraph were designed and prepared for use by Director Campbell and Assistant Astronomer W. H. Wright. The great southern comet was a conspicuous object in the evening sky for several days and was visible without aid for more than a week. Photographs of it with a portrait lens were secured on May 6. The exposures were necessarily short, but show 3° or 4° tail. A faint streamer is also shown to the south, making an angle of about 35° with the principal tail. A number of large copies, on glass, of the eclipse photographs, as well as lantern slides, were shown at the meeting.

* Two of the four lenses used in Sumatra were kindly loaned for the purpose by Professor E. C. Pickering, Director of the Harvard College Observatory.

A Martian Cloud: Percival Lowell.

This paper gave an account of two projections seen upon the terminator of Mars by Mr. A. E. Douglass at the Lowell Observatory on December 7 and 8, 1900; the observations which gave rise to the popular impression last year of signals from Mars. Calculation showed them to belong to different parts of the planet and to have moved during the time they were under observation. Furthermore, the motion in each case was approximately the same—nearly due west in each case. Neither of them reappeared on any succeeding night. They thus showed themselves to be not illuminated mountain tops, but sunset clouds floating in the planet's atmosphere.

Preliminary Statement of Results of International Magnetic Observations made during the Total Solar Eclipse of May 17–18, 1901: L. A. Bauer.

To further test the results obtained by the United States Coast and Geodetic Survey magnetic parties during the total solar eclipse of May 28, 1900, regarding a slight magnetic effect that may be attributable directly to some change produced in the electrification of the upper atmospheric strata by the abstraction of the sun's rays, due to the interposition of the moon between the sun and the earth, an appeal was made for international cooperation in magnetic and allied observations during the recent total solar eclipse. The repetition of the observations was doubly interesting owing to the fact that the present eclipse occurred in the opposite magnetic hemisphere to that of last year, and hence the opportunity was afforded for ascertaining whether the magnetic effect was reversed in its general character to that of last year, as is, for example, the case with the diurnal variation in passing from one magnetic hemisphere to the other. The conditions, however, for obtaining observations at a number of stations distributed along the belt of totality, as was done last year, and thus testing whether the magnetic effect again followed directly in the wake of the shadow cone, were not favorable owing to the present location of the belt of totality. In response to the appeal, simultaneous magnetic observations were made on May 17 from 14 to 21 o'clock, Greenwich mean astronomical time—an interval amply covering the time of the eclipse—at a number of stations encircling the entire globe, three of which were in the belt of totality. The prime purpose of making the observations so as to cover the entire globe was to furnish the possibility of separating a possible eclipse magnetic effect from a contemporaneous magnetic storm of the usual type. The eclipse effect, for instance, doubtless would be confined to a very small belt, whereas a customary magnetic storm, in conformity with the usual experience, would manifest itself at practically the same moment of time over a very large area, and thus be felt at stations far from the totality belt. At none of the outside stations has a disturbance of any appreciable size been thus far reported to me, the general consensus of opinion of observers at these stations being that 'nothing unusual occurred.' At the three stations within the belt of totality the majority of the opinions is that something unusual did occur during the time of the eclipse. Thus at Karang Sago, where was situated the Dutch eclipse party, Dr. W. van Bermelen, assistant director of the Batavia Magnetic Observatory, observed the change in the magnetic declination and horizontal intensity, and he reports the occurrence of 'an extremely interesting magnetic effect.' He has courteously sent me an extract of his observations made during several days before and on the day of the eclipse, and there certainly appears evidence of a magnetic effect in both elements different from that observed on the days prior to the eclipse. At Sawah Loento, the site of the Massachusetts Institute of Technology party, of Boston, the variations in magnetic declination were observed by Mr. G. L. Hosmer on May 17 and 18. Comparing the two days' results for the interval of the eclipse, there is indisputable proof that something different occurred on the day of the eclipse than on the day before. Namely, at this station, situated so close to the magnetic equator the range of the diurnal variation of the magnetic declination is about one minute of arc. The magnetic effect during the time of the eclipse was of about the same amount, so that a steady *decrease* of east declination resulted during the time of day when normally there is a steady *increase*. There was but one magnetic observatory directly within the belt, viz., the one at Mauritius and this was situated not far from the place of beginning of the eclipse. No special magnetic observations were made at this place; however, the regular photographic curves giving the variations in the magnetic elements were obtained. The declination and the vertical intensity curves apparently do not show any disturbance that could easily be picked out and referred to the eclipse. Regarding the horizontal intensity curve—the more sensitive one—Mr. Claxton states 'that the original curve shows slight tremors between 7.15 and 7.50 and occasionally between 8.5 and 9.0 A. M.' I have plotted this intensity curve on a large scale and find that the curve shows no very marked disturbance that might be readily referred to the eclipse, with the exception of one producing an easily perceptible bulge in the curve amounting to about 3–4 units in the fifth decimal c.g.s. units and lasting about 30 minutes. Anyway the effect, if there be one, is very minute, and will not be so readily separated from the usual diurnal variation as in the case of the two previous stations. Whether this is due to the fact that owing to the vicinity of Mauritius to the beginning of the eclipse, the minute eclipse magnetic storm did not have time to develop itself or was just in the embryonic state, cannot be said. The magnetic effect observed at Karang Sago and at Sawah Loento does not appear to have extended very far outside of the belt of totality, it being scarcely appreciable at the Batavia Magnetic Observatory. My grateful and appreciative acknowledgments are due to all who have participated in this interesting investigation—one to my mind of fundamental importance to the theory of the diurnal variation of the earth's magnetism as elaborated by Schuster and von Bezold.

Meridian Circle Positions of Nova Persei: R. H. TUCKER.

Meridian circle positions were obtained on eight evenings in February and March, and on four evenings in November. The difference in the right ascensions resulting from the two series of observations is 0.05 seconds. The star was more than four magnitudes brighter at the time of the first series than at the second. Making allowance for the magnetic equation, the difference between the right ascensions for the two series reduces to 0.01 seconds. The declinations in the two series differ by 0.05″. It is therefore evident that these observations indicate a very small parallax and proper motion. The large proper motion recently reported by a European astronomer is not confirmed.

On the Parallax of Nova Persei: F. L. CHASE.

This paper was based upon observations made with the Yale heliometer, the first set in February and March, the second in July and August and a third in December. The result derived for the parallax confirmed the value found from the first two sets alone, in which the proper motion could not be taken into account, which value was published in a paper presented at the Denver meeting of the A. A. A. S. last August. This value was practically zero relative to the mean parallax of the two comparison stars employed, stars of about the eighth magnitude. In conclusion the author remarked that, considering its probable error, the value found was not incompatible with that required by the hypothesis advanced by Wolf and others, viz., that the apparent displacements in the nebula surrounding the Nova represent a velocity corresponding with that of an electric wave.

Note on the Parallax of Nova Persei: R. G. AITKEN.

An attempt was made to determine the parallax of Nova Persei from the micrometric measures of six faint stars near it. The first set of measures was obtained, under very unfavorable conditions, shortly after the appearance of the Nova, and a second set on two nights in the latter part of July. The resulting values of the relative parallax were all negative, so that no conclusion can be drawn, unless, possibly, that the parallax of Nova Persei is very small. No account was or could be taken of possible proper motion.

The Energy of Condensation of Stellar Bodies: By R. S. WOODWARD.

This paper considers the density, pressure and energy of condensation from a state of infinite diffusion, of a spherical stellar body in which Laplace's law of density holds. Denoting the potential, density, and pressure at a distance r from the center of such a mass by V, ρ and p, respectively, the problem is stated in three equations, namely:

$$\frac{\delta^2(rV)}{\delta r^2} + 4\pi k r\rho = 0,$$

$$dp = c\rho d\rho = \rho dV,$$

wherein k is the gravitation constant and

c is the constant connecting density and pressure in Laplace's celebrated hypothesis. Assuming the density to vanish at a distance r_0 from the center of such a body, it turns out that V, ρ and p are given by the following formulas, in which ρ_c and p_c are the central density and pressure, respectively, and M is the mass of the star:

$$a = \pi/r_0, \qquad q = \sin ar/(ar),$$

$$\rho_c = M\pi/(4r_0^3), \qquad p_c = M^2k\pi/(8r_0^4),$$

$$V = \frac{Mk}{r_0}(1+q), \quad \rho = \rho_c q, \quad p = p_c q^2.$$

The energy of condensation of such a mass is found to be

$$\tfrac{3}{4}\frac{m^2k}{r_0} = \tfrac{3}{4}Fr_0,$$

where F is the force of attraction between M and an equal mass of infinitesimal volume situated at a distance r_0 from the center of M. It will be observed that the results here given require no hypothesis as to the temperature of such bodies.

Optical Distortion of Photographic Telescopes: HAROLD JACOBY.

The observations discussed in the present paper form part of a more extended series undertaken in the year 1895, having for its principal object a study of the optical distortion of astronomical photographic objectives. A question had been raised as to the fidelity with which photographic telescopes reproduce upon the negative exact relative positions of the stars as they appear on the sky. This matter is fundamental to the art of astronomical photography throughout the entire range of its more important applications to stellar parallax, interstellar motion within the close clusters, and star charting in general; so that the large amount of labor involved even in its partial elucidation does not appear to be superfluous. Valuable cooperation in the work has been granted with ready kindness by several astronomers; and with their aid the special problem under investigation has been solved in a fairly satisfactory manner.

This special problem may be thus stated: Is the scale-value of an astronomical photograph absolutely independent of the direction of measurement on the negative? In other words, if we determine the coordinates of star-images on the plate in millimeters with reference to a pair of rectangular axes, the question is: Will a distance of one millimeter measured from the center of the plate along the X-axis correspond to precisely the same number of seconds of arc on the sky as a distance of one millimeter measured from the same center along the Y-axis? The matter may be put in still another way. Suppose there were upon the sky a number of stars so situated as to form a small but perfectly exact circle. Would a photograph show these stars situated upon a similar exact circle on the negative, or would defects of the object glass distort their position into an ellipse-like oval, after the manner of atmospheric refraction? If this is the case, equal diameters of the circle on the sky will become unequal diameters of the oval on the plate; and, in general, equal distances upon the sky expressed in seconds of arc will become unequal distances upon the plate expressed in millimeters, even after correction for all known sources of difference, such as refraction, aberration, etc.

Various investigations of optical distortion have been published by Donner, Turner and others; but they were all made by methods necessitating a knowledge of relative star positions based on measures other than photographic. To avoid this inherent difficulty, the writer suggested in 1893 a process in which it is not essential to have a precise previous knowledge of relative star positions. It is thus rendered entirely unnecessary either to make a laborious and time-consuming heliometer triangulation, or resort to comparatively inaccurate star-places, such as those obtained with meridian instruments. Proper motion, also, which necessitates new heliometric triangulations made very near the date of the photographic observations, is altogether eliminated in the use of this method.

It is merely necessary to arrange the telescope so that it can be rotated around its optical axis, or some other axis parallel to its optical axis. Suppose two photographs of a group of stars have been made with such a telescope, rotated 90° between the two exposures. If, then, the object glass possesses the peculiarity of making all the Y-coordinates too large in the first exposure, the same peculiarity will show itself in the second exposure by making all the X-coordinates correspondingly too large. Thus it is sufficient to make a series of negatives of the same star-group, rotating the instrument through various angles between the exposures, when a simple comparison will surely bring to light any form of optical distortion depending on the direction of measurement upon the plate.

The process is a purely differential one, and requires only a roughly approximate knowledge of the absolute star-positions, sufficient for the computation of refraction corrections, etc. It can be applied to an equatorial telescope of the ordinary form if we photograph the region immediately surrounding the pole of the heavens. In that case, the polar axis of the equatorial becomes a suitable axis for rotating the telescope, since the polar axis is parallel to the optical axis, when the tube is pointed at the pole. It is obvious that a trial of this method will furnish not only a determination of optical distortion, but will yield also, as a sort of by-product, a photographic catalogue of the close polar stars. For this reason it seemed desirable to include in the work a set of plates of the south pole as well as the north. In this way we should obtain very precise catalogues of both sets of close polar stars, all reduced and computed according to a uniform method.

In 1895 the writer was visting at the Cape of Good Hope Observatory, and discussed the matter with Sir David Gill. The plan met with his approval, and he consented gladly to make the necessary south polar plates. With equal readiness, Dr. Anders Donner, of the Helsingfors Observatory, offered to make the north polar plates. These latter negatives were measured at Columbia University by Mrs. Herman S. Davis and Mrs. Annie Maclear Jacoby; the measures were reduced at Vassar College by Miss C. E. Furness; and they were published by the Vassar College Observatory. The south polar plates were similarly measured and reduced at Columbia by Misses F. E. Harpham, Mary Tarbox, Eudora Magill and H. L. Davis, and the results will soon be published by the Observatory of Columbia University. The researches for both poles agree in showing that the optical distortion depending on direction of measurement is too small to be detected with certainty even by the delicate differential method here described.

W. S. Eichelberger,
For the Council.

(*To be concluded.*)

THE U. S. COAST AND GEODETIC SURVEY.

The last annual report* of the Superintendent of the United States Coast and Geodetic Survey to Congress is fully illustrated with maps and diagrams and presents in detail the work accomplished by this bureau for the fiscal year ending June 30, 1901.

Throughout the report there is frequent evidence of the increased scope of the Survey's operations within the last few years, as well as proof of the flexibility of the

* Now in the hands of the printer.

organization, which appears to have readily adapted its methods to the diverse conditions of our widely distributed possessions.

Appendix 4 in a manner indicates the continuous growth of the area to be charted by the Survey, which has followed upon the territorial expansion of our country. It consists of tables used in the computation of geographical positions. The first publication of this character was limited to the United States, between 23° and 50° of latitude. Two extensions carried the tables to the Arctic Ocean and the present one extends them to the equator.

The physical and social conditions of Alaska and of the Philippines make a strong contrast, and the methods employed in charting the two regions must on that account, to a certain extent, differ. But it appears from the report that there are other conditions common to both which require similar treatment. It is the general belief that both Alaska and the Philippine Islands are on the threshold of a commercial awakening. The rich mineral resources of the former promise steady development, while the many valuable products of the latter only await organized effort to be the source of a boundless traffic. For the safety of the vessels and cargoes engaged in this commerce accurate charts are most important. Those of a large portion of the coast of Alaska and adjacent waters are still constructed from the information obtained by early explorers and navigators, whose facilities for obtaining accurate locations were meager. In the Philippines the charts are truly oriental in their untruthfulness.

It is the policy of the Survey to first attack those portions most urgently needed and the doubtful areas in Alaska are being gradually reduced in size. Thus during the year surveys were extended along the coast of Seward Peninsula where Nome, the focus of the latest and most promising gold fields, is situated. It faces the open sea and at present the transfer of persons and property to and from the vessels is subject to the risks of sudden storms and heavy surf. In the future development of this region a harbor for ocean-going vessels will be a necessity, and with this in view the two nearest, Port Clarence to the north and Golofnin Bay to the east, were included in the Survey. Later in the year the principal passes through the Aleutian Islands into Bering Sea, as well as Icy Straits and Cross Sound, were taken up with every prospect of completion.

In the Philippines, Manila, as the seat of the government, is the central point from which the telegraph lines diverge in all directions. A suboffice and astronomical station were established there, and from the latter as the initial point the longitudes of 14 stations were determined by telegraph and also at the same time latitude and azimuth observations were made. Three charts and notices to mariners were issued and six additional charts were ready for publication on July 1. A steamer was purchased by the Philippine Commission for the use of the Coast and Geodetic Survey, and money was appropriated by the Commission to repair and equip this vessel.

In Porto Rico, hydrographic work was continued in the harbors and bays and offshore. The triangulation around the island and topographic surveys of the shore line were continued. The topographic survey of Vieques Island was completed.

Our home interests were not neglected as may be seen from the fact that hydrographic and topographic surveys were made in localities in 19 States for the purpose of bringing the charts up to date in consequence of natural or artificial changes which have occurred since the original surveys.

Speed trial courses for the use of ships and torpedo boats were established in Delaware and Chesapeake bays, and the Santa Barbara channel course was extended.

In addition to other field and office work, continuous tidal stations were maintained in this country at 6 stations and at 1 in the Philippines, and tide tables for 1902 were published, giving predictions for 70 principal and about 3,000 subordinate stations throughout the world.

During the year the Coast Pilot relating to southeast Alaska was thoroughly revised in the field and prepared for the printer. The field revision of the Coast Pilot between San Diego and San Francisco was completed and new editions of sections relating to the Atlantic coast were published, and the revision and issue of other numbers are in progress.

Strict business methods are not often associated with the measurement of the bases of a great trigonometrical survey. From the literature on the subject it appears that in the endeavor to attain a high degree of accuracy financial considerations have been subordinated to the scientific and experimental. The conduct of the measure of the nine bases along the ninety-eighth meridian was an exception to this rule, and Appendix No. 3, which describes the methods and results has an added interest of novelty. This was the first campaign of a party organized solely for the measurement of bases. A great gain in economy and time was accomplished by taking advantage of the skill acquired by the party by the frequent repetition of the same operations. After a thorough study of former measures a standard of accuracy was determined upon, and the operations so planned, by strengthening some points in the methods, that the number of measures could be reduced and certain refinements omitted. These bases form part of the chain of triangulation which it is proposed to extend along the ninety-eighth meridian, in both a north and south direction from the transcontinental chain, to the boundaries of the United States. It will include an arc of 23°, and together with the transcontinental triangulation as the backbone will form one of the ribs of the main framework for the control of all the triangulation in the United States. The Mexican Government has already in progress a system along the same meridian which, it is expected, will extend the arc 9° in latitude, and it is also possible for the Canadian Government to extend the arc far to the northward. Appendix No. 6 treats of the completed portion of the work in Kansas and Nebraska.

In connection with the general magnetic survey which supplies the data for constructing the compass diagrams on the charts, and furnishes the land surveyor the information for correctly running his traverse lines, observations were made at 374 stations in 30 States and Territories, including Alaska, Porto Rico, Hawaii and the Philippine Islands. In southeastern Alaska places have been examined where local magnetic disturbances affect the compasses of passing ships to such an extent as to endanger navigation.

A magnetic observatory has been established in Maryland, and sites for others have been selected in Alaska and Hawaii. In addition to their regular work, these will cooperate, at the formal request of the German Government, with the international magnetic work to be carried out during the time of the various antarctic expeditions which have been sent out from Germany and Great Britain.

Another piece of work of international interest was executed by the Survey in 1900. Observations were then made with the half second pendulum apparatus, devised by the Survey, at several of the more important European base stations, for the purpose of connecting Washington, which is used as the base for the American pendulum observations. Appendix No. 5 gives the details of the results secured.

A special report on 'The Eastern Oblique Arc of the United States was completed and is being printed as a special publication. It is an important contribution to the subject of geodesy.

Satisfactory results have been obtained at the astronomical observatories maintained under the direction of the Survey at international expense, at Gaithersburg, Md., and Ukiah, Cal., for the purpose of determining the variation of latitude.

The Survey has been represented by its officers on commissions charged with the marking of one international and two state boundaries.

The report refers to the reorganization of the Office of Standard Weights and Measures and its establishment as the National Bureau of Standards by act of Congress March 3, 1901. The principal reasons for the change in order to meet the present requirements of scientific and commercial interests are summarized, and a description of the functions of the new bureau and the proposed buildings and accessories is given in detail.

SCIENTIFIC BOOKS.

A Treatise on Zoology. Edited by E. RAY LANKESTER. Part IV. *The Platyhelmia, Mesozoa, and Nemertini.* By W. BLAXLAND BENHAM, D.Sc., M.A. London, Adam and Charles Black, Publishers; New York, Macmillan & Company. Pp. 204. 114 figs. in text. Price $5.25.

Volume IV. of Lankester's valuable series well maintains the standard set by the parts previously issued, and the lower divisions of the old group 'Vermes' are here treated in a broad and suggestive manner by a well-known helminthologist. The author deserves the gratitude of all zoologists for bringing together in a concise but comprehensive form the many facts that have been accumulated in connection with these lower forms of Invertebrata.

From the nature of the subjects treated the text is necessarily disconnected, but each division is accurately set forth in respect of the structural modifications and types, and each is complete in itself. The divisions which are thus separately treated are: Turbellaria, Temnocephaloidea, Trematoda, Cestoidea, Nemertini, and appendices to the Platyhelmia, including Rhombozoa (*Dicyema,* etc.), Orthonectida, Trichoplax, Salinella, etc. The author adopts Lang's classification of the Turbellaria into Rhabdocœlida, Tricladida and Polycladida; Monticelli's orders of the Trematoda, and Bürger's divisions of the Nemertini. The greatest changes are to be found in the Cestoidea. Here Lang's 'orders' *Cestoda monozoa* and *Cestoda polyzoa* are changed to the 'grades' *Cestoda monozoa* and *Cestoda merozoa,* while each is further divided into sections and orders. Among the *monozoa* we find the orders *Amphilinacea, Gyrodactylacea* and *Caryophyllacea* based upon the characters of the genera similarly named. The *merozoa* are further subdivided into sections *Dibothridiata* and *Tetrabothridiata* according to the number of sucking cups or 'bothria.' In the former there is one order, *Pseudophyllidia* of van Beneden, while in the latter the number of orders is raised to four: *Tetraphyllidia, Diphyllidia, Tetrarhyncha* of van Beneden and *Tetracotylea* of Diesing. (Tæniidæ auct.)

We are particularly pleased with the substitution of the term 'merozoa' for Polyzoa in the classification of Cestoidea and it should do away with the confusion of terms among English-speaking zoologists who adhere to Thompson's term Polyzoa for an order of the Molluscoida. The use of the term 'Mesozoa' in the title of the book is less satisfactory for it perpetuates the probable error of regarding a small group of parasitic and degenerate forms of Platyhelmia (?) as 'intermediate' or primitive types, notwithstanding that this view is strongly attacked in the text, where the word appears only in an historical sense.

An innovation of great value is the introduction of a concise historical statement, in which are given the names and dates of the men who have added to our knowledge of each of the classes considered; and still another feature which adds interest and value to the book, is the frequent allusion to general zoological theories. For example, the relations of the Nemertini to the theories of the origin of metamerism are considered in sufficient detail to make the matter clear. On this particular question the author takes no positive stand one way or the other, but is inclined, on the whole, to follow Hatschek and Mayer. These additions greatly enhance the general interest of technical works like the one under consideration and materially lessen the burden of the load of detail which the student must struggle under.

The style of writing, although somewhat heavy, is clear and definite, and awkward phrases like 'a pair of groups,' and 'than which,' or careless statements, such as 'the very close relationship of these two groups (Turbellaria and Nudibranch molluscs) with the Cœlenterata' (p. 12), are rarely encountered. The author puts himself in the way of a great temptation by describing at the outset what he considers to be an 'ideal' Platyhelminth, and throughout the book we find him, consciously or unconsciously, setting up this ideal as a phylogenetic fetish. Such a method of presentation may or may not be subject to criticism, according as the book is to be used as a text-book or as a reference book. The 'type' method is very handy for teaching purposes, but as a basis for phylogenetic deductions it appears somewhat out of place and becomes a source of possible error. These are but minor criticisms, however, and may be easily overlooked when we consider the many merits and interesting suggestions which the author has embodied in this volume.

GARY N. CALKINS.

COLUMBIA UNIVERSITY.

Yale Bi-Centennial Publications. Contributions to Mineralogy and Petrography from the Laboratories of the Sheffield Scientific School of Yale University: Edited by S. L. PENFIELD and L. V. PIRSSON. 1901. With three plates and several figures.

The volume comprises 'a series of reprints from some of the most important of the papers containing the results of the researches made in the chemical, mineralogical and petrographical laboratories at Yale in the lines of mineralogy and petrography.' Part I. by Professor Penfield includes a history of the mineralogical department and of the development of mineralogy at Yale, which goes back to the first years of the last century and continues since then to represent American mineralogical research. A bibliography of mineralogical papers and summary of new mineral species determined, or of formulas established, is added. Forty-three papers on mineralogical subjects are reprinted, mainly from the *American Journal of Science* between 1850 and 1901; the authors are S. L. Penfield, Geo. J. Brush, E. S. Dana, H. L. Wells and others. Part II. by Professor Pirsson gives a similar history and bibliography for the petrographical department, which, notwithstanding its comparatively recent organization, makes a valiant exhibit even compared with its older companion. Eight petrographic papers, several of classic interest to American petrographers, are reprinted. The volume is a valuable collection of important papers, and a striking record of original research in the departments included.

JOHN E. WOLFF.

HARVARD UNIVERSITY.

Velocity Diagrams. By CHAS. W. MACCORD, A.M., Sc.D. New York, J. Wiley & Sons; London, Chapman & Hall. 1901. 8vo. Pp. 113. Figs. 83. $1.50.

Professor MacCord has published in this form an abstract of lectures forming a part of his course of instruction, illustrating his methods of treatment of problems in kinematics involving the construction of 'velocity diagrams' and supplementing the work embodied in his larger treatise on 'Kinematics of Practical Mechanism.' He has, for many years, found this class of graphical construction peculiarly interesting as bearing upon the work of the designing engineer planning combinations of mechanical movements, and he has developed this feature of his work with rare skill, ingenuity and practicality. The occasional appearance of an article by the same hand in the technical journals, notably in the *Scientific American Supplement,* has been almost the only evidence since the time of Willis that any master-hand has been working in this important field. The present publication places on record, in a convenient form, a considerable collection of such work and one likely to prove valuable to all mechanical engineers and draughtsmen.

The points here discussed and graphically treated are the general principles of the science, angular velocities, instantaneous axes, contact motions, including cams, rolling contacts, eccentric and related motions, linkwork, including 'slow advance and quick return' compositions, which are extensively treated, and, finally, the accelerative motions.

These discussions are concise, accurate, direct and clear. The theory of each case is developed as the construction progresses, in an admirable manner, and the graphical work is always equally clear, exact and legible. The author is an expert in this field and his skilful hand is recognized in the graphical constructions and their beautiful lines quite as well as in the text.

The book is printed on fine paper—which is, in fact, essential to the proper production of the illustrations—and the type and finish are alike appropriate to the artistic work of the writer of the treatise.

R. H. T.

GENERAL.

On behalf of the Committee on Historical Documents of the American Historical Society, Supreme Court Justice Mitchell reported at the last meeting that arrangements had been made for the publication in full of the original journals of Lewis and Clark. These notebooks were deposited with the Society nearly a century ago by Governor Clark at the request of President Jefferson, under whose direction was sent out the expedition which gave the country the first knowledge of the newly acquired northwestern possessions.

The Berlin and Copenhagen Academies of Sciences have commenced the task of collecting all the manuscript left by Galen and compiling a new and complete edition of his works.

The preliminary work upon the preparation of a revised catalogue of the birds of Ohio has resulted in the addition of twenty species to the list since Dr. Wheaton's catalogue was published. Nearly 150 preliminary lists have been sent out for additions and corrections, but hardly a third of them have been returned to date. From those returned annotated much valuable information has been gained, particularly of an ecological nature, furnishing a basis for comparisons with conditions in Dr. Wheaton's time. Considerable field work must still be done in the extreme western, the eastern and the southern fifth of the State before the ideals upon which the work of revision was founded can be even approximately realized. As an aid to the furtherance of this work the compiler solicits information from all who are familiar with Ohio birds, who have not already examined a preliminary list. Communicate with Lynds Jones, Oberlin, Ohio.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON.

The 348th meeting was held on Saturday evening, January 25.

Under the heading of notes W. H. Dall called attention to the practice indulged in by some writers of rejecting names in biology which differ only by terminations indicating gender, as *Cyprina* from *Cyprinus*. He reprobated the practice as, if carried out strictly, likely to overthrow many names which have been in universal use for a century or so, and with absolutely no gain to science. As a particularly glaring instance of this he cited a recent experience with the work of Duméril, 'Zoologie Analytique,' issued in 1806. Duméril gave names to the animals of mollusca, distinct from those applied to the shells, by adding to the latter the termination *arius*. Thus we have the animal of the shell called *Nassa* by Lamarck, referred to a genus *Nassarius* by Duméril. On the ground that this name existed, though like all Duméril's names an absolute synonym, the later genus *Nassaria* of Adams and Reeve has been rejected by a recent writer. On looking up the facts in the case and making a list of Duméril's names for future reference, it was found that among them was one called *Pleurotomarius,* founded on the animal of *Pleurotoma* Lamarck. This, if the above obnoxious custom were adopted, would oblige us to reject *Pleurotomaria* J. Sowerby, and its equivalent *Pleurotomarium* Blainville, for the well-known archaic genus of mollusks which has been accepted by everybody since 1821. The type of *Pleurotomarius* Duméril, furnished by Froriep in his translation of 1806, is *Pleurotoma babylonia* Lamarck, which is the type of Lamarck's genus *Pleurotoma,* 1799.

David Griffiths described, under the title 'A Seed Planter,' the peculiar method by which the seeds of *Plantago fastigata* are enabled to obtain a foothold on the baked plains of the southwest. The seeds of this plant are very abundant and are scattered far and wide, accumulating in every little depression. After the slightest shower these seeds are surrounded by a thick mucilaginous layer which, as it dries and shrinks, creates a minute pit under each seed, into which it sinks and is covered with dust and buried ready to germinate and send down a rootlet after the next shower.

F. A. Lucas presented 'A Phase of the Blue Fox Question,' referring to a paper read before the Society two years ago, in which he described the methods of trapping blue foxes devised by Mr. James Judge and employed on St. George Island of the Pribilof group. He recalled that males only were kept in the endeavor to make the foxes polygamous and his remark that the results of the experiment would be awaited with interest. The present communication gave the observations of Mr. Walter I. Lembkey, Treasury Agent, showing that after four years of trapping there was no evident increase either in the total number of foxes, or in the number of females. The entire paper will be given later in Science.

Rodney H. True discussed at some length 'The Physiology of Sea Water' and a synopsis of the paper will be found in the account of the meeting of the Society of Plant Morphology and Physiology given in Science.

F. A. Lucas.

NATIONAL GEOGRAPHIC SOCIETY.

The meeting of January 10 was devoted almost wholly to business affairs. The following named gentlemen were elected to serve as managers for the ensuing three years: Alexander Graham Bell, Henry Gannett, A. W. Greely, Angelo Heilprin, Russell Hinman, W J McGee, Gifford Pinchot and Otto H. Tittmann. The secretary's report showed an increase in membership, the total being over 2,600.

At the meeting of January 24 Dr. L. A. Bauer, in charge of the Division of Terrestrial Magnetism, U. S. Coast and Geodetic Survey, gave an account of the magnetic survey of the United States now being prosecuted. The importance of an accurate knowledge of the variation of the magnetic compass was dwelt on at some length.

The present survey involves a determination of the compass variation throughout the United States and the publication of the results in such form as shall be most useful to those interested. Stations about 25 miles apart have been established for the purpose of ascertaining the compass variation, while four magnetic observatories have been installed at the following named places: Cheltenham, Md.; Baldwin, Kans.; Sitka, Alaska, and Honolulu, Hawaii. At these observatories complete records of all the magnetic elements will be obtained.

The second paper of the evening was by Mr. James Page of the Hydrographic Office, Navy Department, on Ocean Currents. Mr. Page showed that an intimate relation existed between the general atmospheric circulation and the system of ocean currents, and that the latter were due directly or indirectly to the frictional action of the wind. The rate of drift of ocean currents varies greatly; in extreme cases it might be as much as 75 to 100 miles in 24 hours, but generally it is very much less, not more than 20 to 30 miles in 24 hours.

A. J. Henry,
Secretary.

SCIENCE CLUB, UNIVERSITY OF WISCONSIN.

At the December meeting of the Science Club of the University of Wisconsin, December 17, Professor T. C. Chamberlin, of the University of Chicago, gave an address entitled, 'Some Further Studies as to the Early States of the Earth.' The nebular hypothesis of the origin of the earth, as stated by Laplace, was discussed, and a brief summary made of certain tests to which the theory had been put by Professor Chamberlin and others, as described by Professor Chamberlin in various publications. It was concluded that the Laplacean hypothesis will not stand fundamental tests and that some modification of the hypothesis or some new hypothesis is necessary.

Professor Chamberlin's researches have furnished criteria for a new hypothesis of the origin of the earth. The parent body out of which the solar system was evolved must have been one which possessed limited matter; a very small proportion of matter near the exterior with very high energy of movement; in the central portion very low energy of movement, and with the conditions in the central portion permitting the development of a spherical body as the controlling center.

The earth in its early history may be conceived to have been a small body, growing gradually by the infall of material from without, without, in the early stages, an atmosphere, because of its incompetency to hold one. The atmosphere, instead of being the dominant phenomenon at the beginning of the earth, was practically absent from the exterior of the earth until it was $\frac{1}{10}$ or more grown. Gradually the accretion of the atmosphere permitted the gathering of water vapor, and this by condensation at length formed the oceans. These thenceforth protected the infalling matter of that portion of the earth, for matter falling into water does not undergo as ready decomposition as that which falls upon the surface. This process going on from age to age gave to certain areas a higher specific gravity than other portions. We therefore have an explanation of the superior gravity of the portion of the earth lying under these beds of water as compared with the land, and thus, perhaps, of the great depth of ocean basins.

It is obvious that from a very early stage volcanic action must have arisen from the excessive heat generated in the interior through self-compression of the mass, as may be shown by mathematical calculation. The volcanic action would affect certain substances before others, and the selection thus made from the time of its inauguration, when the earth was perhaps not more than $\frac{1}{80}$ or $\frac{1}{100}$ grown, is sufficient to explain the present distribution of volcanic matter.

Another phase of the history of the earth may be traced in this way: If the temperature of the interior is sufficiently accounted for by compression, the temperature developed by the infall of matter may have been made available for the sustenance of life at a very early period. Therefore we escape the objections raised by geologists against the prolonged era of evolution insisted upon by biologists.

C. K. Leith.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

At the meeting of the Academy of Science of St. Louis on the evening of January 20, Dr. George Richter delivered an address on the physical and chemical properties of gelatin, which he described as a spongy substance differing materially from other solids. The manner of manufacture of gelatin and its chemical and physical characters were described in detail, and considerable attention was given to the rate of absorption and evaporation of water by gelatin, and the phenomenon of its apparent solution in water. A new hygrometer was exhibited and described, the action of which was based upon the water absorption of gelatin.

At the meeting on February 3, Mr. Trelease presented, with the aid of lantern illustrations, some of the principal results of his recent studies of Yuccas and their allies.

William Trelease,
Recording Secretary.

DISCUSSION AND CORRESPONDENCE.

WIRELESS TELEGRAPHY.

To the Editor of Science: I wish to enter formal protest against the statement concerning Wireless Telegraphy, on page 112, etc., of the issue of Science for January 17.

In anything that I may say let it be understood that I am not personal to Professor Franklin, who brings the editorial from London *Electrician* to our attention. The readers of SCIENCE need no statement from me as to Professor Franklin's qualifications.

It is too much the habit of scientists to be conservative about the application of scientific theory to commercial use. It seems to be an attitude which it is impossible to avoid; and the limitations of the individual are usually regarded as those of the science. For this reason I protest against the conclusions so hastily drawn in the present immature stage of the art of Wireless Telegraphy, viz., that it is practically incapable of any substantial extension. In this connection I quote from the *Scientific American* Supplement, the issue of August 5, 1882, page 5490, from an article called 'Electro-Mania' by W. M. Williams.

> I well remember making this journey to Boxmoor (upon one of the early steam railway carriages on the London and Northwestern Railway), and four or five years later travelling on a circular electro-magnetic railway. Comparing that electric railway with those now exhibiting, and comparing the Boxmoor trip with the present work of the London and Northwestern Railway, I have no hesitation in affirming that the rate of progress in electro-locomotion during the last forty years has been far smaller than that of steam. The leading fallacy which is urging the electro-maniacs of the present time to their ruinous investments is the idea that electro-motors are novelties, and that electric lighting is in its infancy; while gas lighting is regarded as an old, or mature middle-aged business, and, therefore, we are to expect a marvelous growth of the infant and no further progress of the adult.

This quotation is a type. Further, application of scientific theory to the affairs of man has from time immemorial been met by the scoffs not only of the ignorant (which may be borne with equanimity), but of those who ought to know better. The article by Mr. Williams was written after the birth of the dynamo, and he was doubtless incapable of distinguishing then between the old galvanic battery electric railways and those which followed the development of mechanical electric contrivances. We now know that the electric railway, so lightly characterized then, is an every-day matter involving the use of more capital than all other electric contrivances combined. The capital liabilities of the electric railways in the United States alone amount to $2,000,000,000; the telegraphs of the United States amount to $175,000,000, and the telephone systems of all kinds to a little less than $250,000,000.

Further, I protest that the entire article in the London *Electrician* is of the most unscientific character, utterly unworthy the attention of any one who tries to preserve fair-mindedness; and again that it misrepresents facts in the baldest manner; take such an example as this:

> The wireless channel of transmission will be rigorously avoided by business men, to whom a guarantee of secrecy and the certainty of a recorded message are absolutely indispensable. Wireless signals in the ether can never be secret; it must always be possible to intercept them. And messages received in no more permanent form than by sounds in a telephone are too evanescent and uncertain to commend themselves to the purposes of commerce.

And this in spite of the fact that the most enormous transactions are undertaken and consummated by telephone!

Ipse dixit predictions of this kind are unscientific. The scientist who has learned to distinguish between 'It can't be done' and 'I can't do it' has learned something which the evanescent gentleman who penned the article brought to our attention has certainly neglected. A caution against undue haste or boldness of prediction is all right; but predictions of what cannot be done are all wrong, and very much further wrong, because they neglect all the teachings of the past, and instead of adopting a Baconian philosophy would render it impossible for scientific men to obtain the means of pursuing investigations.

T. J. JOHNSTON.

SHORTER ARTICLES.

THE DISCOVERY OF TORREJON MAMMALS IN MONTANA.

LAST spring (1901), after it was decided that an expedition should be sent from Princeton

University to the region of the Musselshell river in Montana, the writer suggested to Professor W. B. Scott the possibility of finding fossil mammals in the Fort Union beds which are so well developed in the Crazy Mountains and vicinity. It was his idea that in a country where the Laramie, Livingston and Fort Union beds occur and attain a considerable thickness, the long-sought ancestors of the placental mammals of the Puerco might be found.

In the region where the camp was established, near Fish Creek, to the eastward of the Crazy Mountains, the writer had found, during the previous year, near the top of the series of rocks so beautifully exposed in this region, many fossil deciduous leaves. Many of these were in a hard, fine-grained sandstone and were excellently preserved. Below the layers of sandstone containing the best leaves were dark or gray shales in which were carbonaceous matter, plant impressions and distorted gasteropod shells, interstratified with layers of quite hard gray sandstone, which were often ripple marked. Still lower were dark gray shales with concretions, and bands or lenses of limestone containing fresh-water Bivalves and Gasteropods. The concretions are brown (ironstones) and break in angular fragments. The shales are partly soft and fine-grained and in part sandy.

During the greater part of last summer the writer was collecting for the Princeton Museum and was with the Princeton party during their stay in this region. In August, while ascending the butte from which leaves had been procured the previous year, and examining the dark shale beneath the sandstone cap, he found fragments of a tooth, which, when put together looked like the canine tooth of a mammal. Near it a premolar was found that at once settled the matter. It appears to belong to a small species of *Pantolambda*. This level was followed and carefully searched. Several teeth of *Euprotogonia* were found and fragmentary remains of one or two more mammals, besides teeth and fragments of jaws of crocodiles. This exposure was small. Afterward on another side of the butte, ravines which exposed the shales at about the same level were examined, and other bones and teeth were found.

These mammalian remains, which are now in the Princeton Museum, have been examined by W. B. Scott, M. S. Farr, and W. D. Matthew, as well as by the writer. One or two have been specifically determined and all agree that the beds belong to the Torrejon horizon. The fossils determined are:

Mioclænus acolytus (Cope),
Anisonchus close to *A. sectorius*,
Euprotogonia,
Pantolambda (?),
Psittacotherium (?).

This is a very interesting discovery, as heretofore Torrejon mammals have been found only in a limited area in New Mexico, and the beds have been searched with the greatest care, 'on hands and knees,' with a scientific zeal to know more of the peculiar mammals of this age.

The importance and interest of the discovery are doubled by the fact that everything seems to indicate that these are the Fort Union beds, the exact position of which has been uncertain. The collection of fossil leaves that was made in the summer of 1900 has been sent for with a view to the accurate determination of the species. As the Fort Union flora is a characteristic one it is confidently believed that the plants together with the mammals will settle the position of the Fort Union formation beyond controversy.

EARL DOUGLASS.
PRINCETON, N. J.

ENGINEERING NOTES.

ECCLES, a small town in England, has introduced the automobile fire-engine. It carries five men, three hundred feet of hose and standpipes, ladders, jumping sheet, etc. It is driven by an electric motor at a speed, on a smooth and level pavement, of about fifteen miles an hour. It climbs heavy gradients and is reported to be preeminently satisfactory. The self-propelled steam fire-engine has often been built, in the United States and abroad, and has sometimes proved satisfactory, though usually too heavy. The electric machine has at least one peculiar advantage in its instant readiness for work. No delay is compelled as in starting fires and getting up steam or in waiting for horses, and immediately the alarm is heard, the attendant can jump upon his engine and start for the fire. In large cities, with their paid fire departments where the steam fire-engines always stand with water hot and steam making, and the horses and crews ready to move out of the house in intervals measured by seconds, this is a matter of less consequence; the engine will seldom fail to start promptly and to have steam ready before reaching its position at the fire. With small places, the case is very different. There, the engine is cold, no crew at hand, the horses often in a detached stable, or even at some distance, and in many cases hand-power only available. In such places, should a source of supply be at hand for charging batteries, the electric automobile fire-engine would prove ideal.

THE advance made to date in the production of locomotives for heavy work is illustrated by the completion, recently, for the Atchison road, by the Schenectady Locomotive Works, of a ten-wheel engine weighing 275,000 pounds; while the progress of the business of locomotive construction is evidenced by the acceptance of orders by the Baldwin Works to an aggregate of seven hundred engines of all styles for the year 1902.

The Providence Journal owns an electric automobile, which has been working since the early autumn. It has traversed 1,000 miles and is expected to make the record 1,500 or 1,800 before its batteries will require replacement. The normal output is 22 amperes; but it has risen to 80 when ascending the hill to Brown University from Market Square. It has shown the practicability of rising a 10 per cent. gradient, although at serious cost in life of battery. It is estimated by the *Journal* that the cost is about that of keeping a single horse and carriage.

R. H. T.

BOTANICAL NOTES.

THE 'BROWN DISEASE' OF POTATOES.

FOR several years the potato crop of Nebraska has been seriously damaged by a disease which causes the fibro-vascular bundles to turn brown. This disease appears to be widely distributed in both America and Europe, but as yet nothing satisfactory has been published in this country concerning the cause of the trouble. About the first of March, 1901, Mr. J. A. Warren, now of the Santee Normal Training School, began a series of experiments in the botanical laboratories of the University of Nebraska in order to determine if possible what produced the disease. He now reports as follows: "My first cultures soon showed tufts of mould filaments projecting from the diseased bundles, and in a few days there were many ripe fruits of *Stysanus stemonites* (Pers.) Corda. I repeated the experiment many times, using both affected and unaffected tubers from different fields. In nearly every case the cultures containing brown bundles produced Stysanus, while those containing no brown bundles produced no Stysanus. Tubers grown at Lincoln, Harvard, Humboldt and Santee, Nebraska, and Cedar, Minnesota, were used, always with the same results. These experiments have now been continued for about eight months, and I hope to follow them the coming season. The results seem to show that *Stysanus stemonites* is the cause of the disease."

The importance of this discovery lies in the fact that this appears to be the first record which connects *Stysanus stemonites* with this disease in this country, as well as the first record of its occurrence.

MORE ON THE PHILIPPINE FLORA.

THE Forestry Bureau of the Philippine Islands has issued a sixteen page pamphlet on the 'Tree Species,' giving the scientific and common names, the families and a little information in regard to the usefulness of the trees in the industries. No less than sixty-one families are represented, and the whole number of species enumerated is six hundred and twenty-two. The larger families are Urticaceae, with 45 species; Leguminosae, 42; Euphorbiaceae, 30; Myrtaceae, 28; Rubiaceae, 28; Sapotaceae, 24; and Lauraceae, 22. Of the Cupuliferae there are 13 species, two of which are species of Castanopsis, the remainder being species of Quercus. There are 18 species of Palms (Palmaceae), and 5 of Coniferae. A solitary species (*Vernonia arborea vestita*) represents the arboreus Compositae of the islands.

A second publication of the same bureau, 'The Spanish Public Land Laws of the Philippine Islands,' is worthy of notice here. This consists of translations and compilations of the principal laws which governed the sale of the public lands in the islands under Spanish rule. It is worthy of mention that the Spanish laws made provision for the reservation of those tracts of land which are denominated 'forest zones,' and of which it is declared that 'the state desires to hold for the commonwealth.' It is further declared in regard to these forest zones that 'no private ownership can be claimed in them by any process of law, unless they are explicitly declared to be salable by competent authority.' One may wish that such wise counsels had prevailed when our forefathers took possession of the forest wealth of this country. Had this been done we should not now be trying to save the last of our forests by the reservation of such mere fragments as have escaped destruction because scarcely worthy of notice by the lumbermen.

ANOTHER TEXT-BOOK OF BOTANY.

A LITTLE book entitled, 'Outlines of Botany,' prepared by R. G. Leavitt, of the Ames Botanical Laboratory at North Easton, Mass., 'at the request of the Botanical Department of Harvard University' is very suggestive of the change which has taken place in our notions as to the proper study of plants in the high schools. Here is a book 'based on Gray's Lessons in Botany,' which is as different from the book of which it is supposed to be a modification as can well be imagined. In fact the preface indicates as much, when it speaks of many schools 'having outgrown certain now antiquated methods of teaching botany.' Instead of a book of lessons to be *memorized,* we have here a book to be *worked through* in the laboratory, with the proper material and appliances at hand. Only one feature of the new book has a familiar look, viz., the illustrations, over which some of us bent thirty-five years ago. All else is new, and to these old-time friends are added many new ones in order to illustrate the new topics and new treatment.

The treatment of the subject may be made out from the headings of the chapters, some of which are as follows: 'Laboratory Studies of Seeds and Seedlings,' 'Laboratory Studies of Buds,' 'Laboratory Studies of the Root,' and so on for the stem, the leaf, the flower, the fruit and the 'Cryptogams.' After each laboratory chapter there follows one of general discussion on the same subject. The closing chapters are devoted to the 'Minute Anatomy of Flowering Plants' and a 'Brief Outline of Vegetable Physiology.' The book is thus an introduction to modern botany, and since it is to be presumed that it has had the oversight of the eminent men in the Department of Botany in Harvard University, we need not be surprised at its excellence, although its author is yet a comparative stranger in botanical circles. We are glad to welcome the book as a valuable addition to the text-books for use in high schools.

INDIAN USES OF PLANTS.

IN a recent bulletin of the Division of Botany of the United States Department of Agriculture, Mr. V. K. Chesnut tells of the uses which the Indians of Mendocino County, California, make of a large number of plants, ranging from red seaweeds, fungi, lichens, ferns and conifers to flowering plants. Fibers, medicines and food constitute the principal uses which the Indians make of the wild plants of the region studied. One is astonished at the large number of fiber plants used by these people, and the question arises after reading this account whether the whites are not allowing valuable native fibers to go to waste. We have probably little to learn from the Indians in regard to the medicinal values of plants, but when we come to the food plants we are again inclined to wonder whether these primitive people may not be able to teach us to make better use of the products of the soil. The number of plants whose seeds yield wholesome food is very much larger than we had supposed possible. One curious feature in the food habits of these Indians is brought to light, viz., that they eat clover (species of Trifolium), not the flower-heads, as white children do sometimes, but the leaves and stems, quite after the manner of other herbivorous animals! "From the beginning of April along into July it is no uncommon sight to see small groups of Indians wallowing in the clover and eating it by handfuls, or to see an Indian squaw emerging from a patch of clover and carrying a red bandana handkerchief full of the crisp stems."

CHARLES E. BESSEY.

THE UNIVERSITY OF NEBRASKA.

ELIZABETH THOMPSON SCIENCE FUND.

THIS fund, which was established by Mrs. Elizabeth Thompson, of Stamford, Connecticut, 'for the advancement and prosecution of scientific research in its broadest sense,' now amounts to $26,000. As accumulated income will be available November next, the trustees desire to receive applications for appropriations in aid of scientific work. This endowment is not for the benefit of any one department of science, but it is the intention of the trustees to give the preference to those investigations *which cannot otherwise be provided for,* which have for their object the advancement of human knowledge or the benefit of mankind in general, rather than to researches directed to the solution of questions of merely local importance.

Applications for assistance from this fund, in order to receive consideration, *must be accompanied by full information,* especially in regard to the following points:

1. Precise amount required. Applicants are reminded that one dollar ($1.00 or $1) is approximately equivalent to four English shillings, four German Marks, five French francs, or five Italian lire.

2. Exact nature of the investigation proposed.

3. Conditions under which the research is to be prosecuted.

4. Manner in which the appropriation asked for is to be expended.

All applications should reach, before April 1, 1902, the Secretary of the Board of Trustees, Dr. C. S. Minot, Harvard Medical School, Boston, Mass., U. S. A.

It is intended to make new grants in April, 1902.

The trustees are disinclined, for the present, to make any grant to meet ordinary expenses of living or to purchase instruments, such as are found commonly in laboratories. Decided preference will be given to applications for small amounts, and grants exceeding $300 will be made only under very exceptional circumstances.

A list of the grants recently made is given below.

(Signed.)

HENRY P. BOWDITCH, *President.*
CHARLES S. RACKEMANN, *Treasurer.*
JAMES M. CRAFTS.
EDWARD C. PICKERING.
CHARLES-SEDGWICK MINOT, *Secretary.*

1900.

$200, to Dr. H. H. Field, Zürich, Switzerland, to aid in the publication of a card catalogue of biological literature.

$500, to S. H. Scudder, Esq., Cambridge, Mass., for the preparation of an index to North American Orthoptera.

$300, to Professor P. Bachmetjew, Sofia, Bulgaria, for researches on the temperature of insects.

$250, to Dr. E. S. Faust, Strassburg, Germany, for an investigation of the poisonous secretion of the skin of Amphibia.

$250, to Professor Jacques Loeb, Chicago, Ill., for experiments on artificial parthenogenesis.

$650, to the National Academy of Sciences, Washington, D. C., towards the expenses of three delegates to attend the conference of academies at Wiesbaden in October, 1899, to consider the formation of an International Association of Academies.

1901.

$150, to Professor E. W. Scripture, New Haven, Conn., for work in experimental phonetics.

$300, to Professor W. Valentiner, Heidelberg, Germany, for observations on variable stars.

$50, to A. M. Reese, Esq., Baltimore, Md., for investigation of the embryology of the alligator.

1902.

$125, to F. T. Lewis, M.D., Cambridge, Mass., for investigation of the development of the vena cava inferior.

SCIENTIFIC NOTES AND NEWS.

THE American Philosophical Society has elected Dr. Samuel P. Langley, secretary of the Smithsonian Institution, to be vice-president of the Society, and Dr. Ira Remsen, president of the Johns Hopkins University, to be one of the councilors.

'THE Races of Europe,' by Professor W. Z. Ripley, of the Massachusetts Institute of Technology, and professor-elect of economics at Harvard University, has been 'crowned' by the award of the prix Bertillon of the Société d' Anthropologie of Paris.

PROFESSOR J. W. GREGORY has been appointed acting head of the Geological Survey of Victoria, with a view to its reorganization.

M. MICHEL LEVY, inspector of the French mines, has been appointed a member of the council of the Conservatory of Arts and Measures.

THE foreign papers report that Professor Virchow, who has been confined to the house as the result of a fall, is making good progress towards recovery.

THE Medical Advisory Board of the Health Department of New York City has organized by electing Dr. Edward G. Janeway chairman and Dr. T. Mitchell Prudden secretary.

DR. F. W. PAVY, F.R.S., has been chosen president of the National Committee for Great Britain and Ireland at the Fourteenth International Congress of Medicine to be held at Madrid in April, 1903.

DR. JOHN D. JONES, formerly assistant chief of the bureau of forestry, and more recently a representative of the Department of Agriculture for the purpose of investigating the condition of agriculture in Asia, Hawaii and the West Indies, was appointed in June, 1899, as technical adviser to the Japanese department of agriculture and commerce. In recognition of his services the Emperor has recently conferred on him a high order.

DR. SAMUEL G. DIXON, president of the Philadelphia Academy of Natural Sciences, has been formally notified of election to honorary membership in the National Society of Natural Science and Mathematics, Cherbourg.

DR. J. W. LOWBER, of Austin, Tex., has been elected a fellow of the Royal Astronomical Society of London.

DR. T. H. MACBRIDE, professor of botany in the State University of Iowa, has been invited to deliver the address at the opening of the new library building at Muscatine. The address is to be given under the auspices of the Fortnightly Club of that city.

IN a course of lectures at Trinity College, Professor H. S. Graves, of Yale Forest School, will give 'Problems of American Forestry' March 11, and Rev. Henry C. McCook, D.D., 'The Homes and Habits of American Ants.' In addition Dr. McCook will address the students of the department of natural history upon spiders.

THE Navy Department has extended for six months the leave of absence granted to civil engineer Robert E. Peary, now in the Arctic regions.

DR. EDWARD PALMER, the veteran explorer of Mexico, left Washington on January 15 for a collecting expedition in the province of Santiago, Cuba. He will obtain the usual number of sets, which will be offered for sale upon his return. Dr. Palmer will be accompanied by Mr. Charles Louis Pollard and Mr. William Palmer, both of the United States National Museum, who will collect plants, mammals, birds and reptiles for that institution. As the party will pay especial attention to the unexplored mountains in the southern portion of the province, it is expected that the scientific results will be valuable.

PROFESSOR RALPH S. TARR, of Cornell University, is spending the winter in geological study in Italy and will spend the spring and summer in the study of the glacial deposits of Germany and the British Isles.

Nature states that an expedition to Lake Eyre, the great depression in Central Australia sinking below sea-level, has recently left Melbourne. The party consists of Professor J. W. Gregory, his assistant, Mr. H. J. Grayson, and five students of the geological department of the Melbourne University. The main objects of the expedition are the study of the physical history of the Lake Eyre basin and the collection of fossils, especially the extinct giant vertebrates. The camel caravan starts from Hergott Springs, a station 440 miles north of Adelaide. It is hoped that the collections will throw light on some unexplained native traditions as to former giant animals that inhabited the Lake Eyre basin.

A bust of Sir Frederick Bramwell has been presented to the Royal Institution, of which he was formerly honorary secretary.

At the celebration of University Day at the University of Pennsylvania on February 22, a portrait of Benjamin Franklin, by Gainsborough, will be presented by the class of 1852.

Dr. Paul F. Mundé, the well-known New York gynecologist, at one time professor at Dartmouth College, died on February 7, aged fifty-five years.

Alfred Brashear Miller, D.D., LL.D, president emeritus of Waynesburg College, Waynesburg, Pa., died on January 30, aged 72 years. He had been identified with the college from its foundation in 1851, having been president for 40 years and president emeritus three years.

Commissary-General G. D. Lardner, an Englishman who contributed to the advancement and popularization of astronomy, has died at the age of eighty-four years.

The British National Physical Laboratory at Bushy House will be officially opened on March 19.

At the annual meeting of the Association of American Universities which opens at Chicago on February 24, the following four main questions will form the basis for discussion:

(1) 'The scope and character of the dissertation required for the degree of Doctor of Philosophy'; (2) 'The membership and policy of the Association of American Universities: Should it be enlarged, and, if so, under what principle of selection? Should the Association devote its attention to questions of graduate work in the arts and sciences exclusively, or shall it also consider and include law, medicine, theology, and political science?'; (3) 'What is research in a university sense, and how is it best promoted?' and (4) 'The degree of Master of Arts: Shall the granting of this degree be encouraged, and, if so, what should it mean, and under what conditions shall it be given?'

These four topics have been assigned respectively to the University of Chicago, the University of California, Clark University, and Cornell University.

The annual congress of the British Sanitary Institute will be held in Manchester on September 9–13. The section of sanitary science and preventive medicine will be presided over by Sir J. Crichton Browne; that of engineering and architecture by Sir Alexander Binnie; and that of physics, chemistry and biology by Professor A. Sheridan Delpéine.

The board of directors of the American Academy of Political and Social Science, at its annual meeting in Philadelphia, elected the following officers: Professor Leo S. Rowe, *President;* Samuel McCune Lindsay, Franklin H. Giddings and Woodrow Wilson, *Vice-Presidents;* James T. Young, *Secretary.*

At the annual meeting of the Peary Arctic Club, the present officers were reelected: M. K. Jesup, *President;* H. W. Cannon, *Treasurer;* and H. L. Bridgman, *Secretary.* Resolutions were adopted congratulating Lieutenant Peary on rounding in 1901 the northern end of the Greenland Archipelago.

A civil service examination will be held on March 25 to fill the position of computer in the Bureau of Forestry, at a salary of $1,000 a year. On the same day an examination will be held for the position of piece-work computer in the Naval Observatory and also for a similar position in the Nautical Almanac Office. On March 4 there will be an examination for the position of seed laboratory assistant in the Bureau of Plant Industry, at a salary of $720.

The feasibility and advisability of adopting the metric system of weights and measures in the United States will be the subject of discussion at a stated meeting of the Franklin Institute of Philadelphia on February 19. The basis of the discussion will be the report of a special committee, which is as follows:

Whereas, It is desirable to obtain an international Standard of Weights and Measures, also to simplify and regulate some of our existing standards; and,

WHEREAS, The Metric System is commendable not only as a suitable International Standard, but also for facility of computation, convenience in memorizing and simplicity of enumeration;

Resolved, That the Franklin Institute approves of any movement which will promote the universal introduction of the Metric System with the least confusion and expense.

Resolved, That the National Government should enact such laws as will ensure the adoption of the Metric System of Weights and Measures as the sole standard in its various departments as rapidly as may be consistent with the public service.

AT a recent meeting of the convocation of the University of London the following resolution was passed: "That this House is of opinion that, in the interests of commerce, science and education, legislation should be promptly undertaken to make compulsory in this kingdom, after a proper interval, the use of the metric system of weights and measures for all purposes."

WE take the following items from the current issue of *The Botanical Gazette:* Dr. E. B. Copeland, formerly of the University of West Virginia, is engaged in research work at the University of Chicago.—Dr. Bradley M. Davis, of the University of Chicago, has returned to his work from a stay in Paris. —Miss Josephine E. Tilden, of the University of Minnesota, has returned from an exploring trip on the Vancouver coast.—Dr. John M. Coulter, formerly of Syracuse University, has been appointed professor of botany in the Manila Normal School, Philippine Islands.

MR. S. HARBERT HAMILTON has started on a scientific exploring and collecting trip in the vicinity of Santiago, Cuba. Collections will be made in all branches of natural history, the bulk of which will go to The New York Botanical Gardens, The American Museum of Natural History and The Academy of Natural Sciences of Philadelphia. Specialists or institutions desiring material direct from the locality are invited to correspond with Mr. Hamilton at Santiago, Cuba.

AT a meeting of the Zoological Society of London on December 3, a series of papers on the collections made during the 'Skeat Expedition' to the Malay Peninsula in 1899–1900 was read. Mr. F. G. Sinclair reported on the Myriapoda, and enumerated the forty species of which specimens had been obtained. Of these, nine were described as new to science. Mr. W. F. Lanchester contributed an account of a part of the Crustacea, viz., the Brachyura, Stomatopoda and Macrura, collected during the Expedition, and described six new forms. Mr. F. F. Laidlaw enumerated the Snakes, Crocodiles and Chelonians which had been obtained, and described two new species based on specimens in the collection. An appendix to these papers, drawn up by Mr. W. W. Skeat, contained a list of names of the places visited by the members of the 'Skeat Expedition.'

OUR consul general at St. Petersburg writes to the Department of State that the gradual deforestation of Russia is attracting increased attention throughout the Empire, and the Forestry Society, as well as the forestry department of the Ministry of Agriculture and Domains, are discussing means for regulating the consumption of timber and for propagation. 'Wooden Russia,' as it is familiarly called, does not appear to be in any immediate danger, as a recent official report states that forests in this country now cover a gross area of 188,000,000 hectares (464,548,000 acres). Among European countries, Sweden comes next, with 18,000,000 hectares (44,478,000 acres) of forest. In Russia, the forests cover 36 per cent. of the whole imperial area. The Swedish forests occupy 44 per cent. of the total area, and the Austro-Hungarian 32 per cent. of the territory of the Dual Monarchy. Reckoned by the population, there are 2 hectares (4.9 acres) of forest to each inhabitant in Russia, 3.85 hectares (9.5 acres) in Sweden, 4.22 hectares (10.4 acres) in Norway, and 0.28 hectare (0.69 acre) per head in Germany. The forests have a greater importance for Russians than for people of West European countries, as villages and country houses are largely built of wood, stone and brick houses being almost unknown, and the forests furnish the main sources of fuel supply. While the imperial committee complains that it is private owners who are recklessly devastating the forests and urges that adequate laws and regulations be enacted to prevent this, the Forestry Society calls attention to the fact that, according to the official report of the forestry department of the Ministry of Agriculture and Domains, the Crown forests furnished a revenue of 17,600,000 rubles ($9,064,000) in 1890 and 48,000,000 rubles ($24,720,000) in 1899. It is claimed that this advance in nine years could not be due to the natural increase of timber growth, and it is urged that the Government set an example in moderation.

UNIVERSITY AND EDUCATIONAL NEWS.

The Laboratory of Engineering, presented to the Stevens Institute of Technology by Mr. Andrew Carnegie, at a cost of $55,000, was dedicated on February 6. Mr. Carnegie made a speech and was presented by President Morton with a silver box containing a piece of the first 'T' rail ever made, the rail that was invented by Robert L. Stevens and was made in 1830 by Sir John Guest at his works in Wales, under the personal supervision of Mr. Stevens.

The new Hall of Liberal Arts of the State University of Iowa, erected and equipped at a cost of about $200,000, was dedicated on January 23.

Waynesburg College celebrated its semicentennial anniversary in November last at which time gifts to the endowment amounting to $36,000 were announced. Col. J. M. Guffey, of Pittsburg; J. V. Thompson, Esq., of Uniontown, and Timothy Ross, John Rose and T. J. Wisecarver, of Waynesburg, contributed $5,000 each. The enrolment of students last year was 391.

Mr. Warren A. Wilbur, of South Bethlehem, Pa., has given an additional $5,000 for the equipment of the new mechanical laboratory at Lehigh University.

The midwinter edition of the Cornell University *Register*, just published, gives the first official and precise census for the current year. The figures are the following: Trustees, 39; teachers, 387; students, graduate department, 183; graduate students in undergraduate departments, 185; academic department, 817; law school, 197; medical college, 415; college of agriculture, 86; veterinary college, 51; college of forestry, 38; college of architecture, 50; college of civil engineering, 212; Sibley college (mechanical, including railway, electrical, marine, etc.), 784. The total of all classes and courses is 2,792 in the regular lists and about 500 in the summer schools. Of the total 1,679 come from New York State, the remainder from every State in the Union and from all parts of America and of the British Empire, from China, Japan, Russia, Switzerland, Austria, Turkey and Korea. Of the 784 students in the undergraduate courses of Sibley College, 62 are graduate students; there are also 14 candidates for the Master's degree and 2 graduate students not candidates for a degree. There are 4 candidates for Ph.D., taking their major work in M.E., and one D.Sc., making a total for 1901–2 of 805 students in all classes and courses.

The Wesleyan University Summer School of Chemistry and Biology will be organized in July, 1902, and will be open for a period of four weeks. It will be in charge of Professors W. O. Atwater, W. P. Bradley and H. W. Conn, aided by a number of assistants.

Professor William L. Robb, of Trinity College, has been appointed head of the new department of electrical science in the Rensselaer Polytechnic Institute, Troy, N. Y.

Dr. George E. De Schweinitz, of Jefferson Medical College, has been appointed professor of ophthalmology in the University of Pennsylvania to succeed the late Dr. W. F. Norris.

Miss Susan M. Hallowell has resigned the professorship of botany at Wellesley College, and has been made professor emeritus. Miss Hallowell was appointed professor of natural history on the opening of the College in 1875.

At Cambridge University Professor T. H. Middleton has been elected professor of agriculture in the place of Dr. Somerville.

Dr. David Welsh, the senior assistant to the professor of pathology in the University of Edinburgh, has been elected the first professor of pathology in Sydney.

The Senior Mathematical Scholarship at Oxford has been awarded to Arthur W. Conway, B.A., Corpus Christi College.

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, FEBRUARY 21, 1902.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE STORY OF THE ESTABLISHMENT OF THE NATIONAL BUREAU OF STANDARDS.

THE passage of a bill, during the closing days of the last session of Congress, providing for the establishment of a National Bureau of Standards, came as a surprise to many. As the work of this bureau ought in the future to have a large bearing upon science and industry it may not be without interest to record the circumstances under which this legislation was effected, and to bring to the attention of those who in the future may be interested in the matter the names of a few men who, though not men of science, gave their time and labor heartily in the interest of this work. It has so happened that, although my own part in this has been very small, the circumstances have been known to me.

The National Bureau of Standards, as the new title reads, grew out of what has been called for many years the Office of Weights and Measures. In the early thirties large discrepancies were discovered in the weights and measures of the United States in the various custom-houses, and Congress authorized the Secretary of the Treasury to establish a shop for the manufacture of uniform standards. In 1836 provision was made for similar standards for the different states, and the 'Office of Standard Weights and Measures' was established.

The Office of Weights and Measures while in law a separate bureau of the Treasury Department, has been practically a part of the United States Coast and Geodetic Survey, and has been, since its organization, under the direction of the superintendent of that bureau. During its existence standards of weights and measures have been furnished to most of the states, and a great impetus has been given to the adoption by international agreement of the metric system. In its custody are kept the international kilogram and meter, and it has for years done a valuable work in the standardizing of steel tapes, thermometers and similar measuring instruments; while more recently it has begun the standardizing of electrical instruments.

On coming to the Coast Survey in 1897 I found the Office of Weights and Measures engaged in the work which I have just mentioned. In its service were two scientific assistants, an instrument maker and a messenger, and a small appropriation was made for office expenses. The work was under the charge of a field officer of the Coast Survey. The arrangement by which a field officer was in this way detailed temporarily for this duty did not seem to me good administration; it deprived the Coast Survey of the service of a much-needed officer, and in addition there was required for this duty not a surveyor but a physicist. I therefore asked Congress to appropriate a salary sufficiently large to induce a physicist of high standing to take charge of the office, under direction of the superintendent. An appropriation of $3,000 was made. With this sum some difficulty was found in inducing any physicist of standing and reputation to accept the place, and only after many interviews and considerable correspondence I succeeded in persuading Professor S. W. Stratton, of the University of Chicago, to become a candidate. The appointment to the position was made after competitive examination.

Mr. Stratton, after coming to the bureau, was instructed to make a report upon the work and efficiency of the office as then constituted, and to recommend, if it seemed advisable, a plan for its enlargement into a more efficient bureau of standards, which might perform in some measure for this country the work carried on by the Reichsanstalt in Germany.

Mr. Stratton entered heartily into this work, and the outcome of his examination was the preparation of a scheme for a National Bureau of Standards. This plan, after being discussed in the office of the Coast Survey, and receiving the criticism of Assistant Superintendent Tittmann and others acquainted with the history of such work abroad, was submitted to a number of physicists, chemists and manufacturers of the country. After their criticisms had been digested a final plan for the bureau was drawn, which is practically that submitted to Congress. In all of this work Mr. Stratton endeavored to avail himself not only of the criticism of those at home, but also of the work which has been done abroad; and the bureau as finally planned is not intended to be simply a copy of the Reichsanstalt, but a standardizing bureau adapted to American science and to American manufacture.

When the final plan had in this way been agreed upon, it was incorporated into a bill and placed before Secretary Gage and Assistant Secretary Vanderlip, of the Treasury Department. The idea at once commended itself to their judgment, and Secretary Gage entered most heartily into a study of the purpose of the proposed bureau, and of the relations which it might have with industry, with commerce and with science. Supported by his hearty advocacy the bill went to the house and was referred to the committee on Coinage, Weights and Measures. The measure was before this committee two sessions, and received from its members long and serious consideration. There appeared before the committee at one time and another, not only men of science, but manufacturers and engineers who were competent to speak on such matters. Amongst all those who appeared in favor of the bill, both before the committee of the House and the committee of the Senate, there was none whose opinion had more weight than that of the Secretary of the Treasury, Mr. Gage. The following extract from his testimony before the Senate committee is worth remembering in the history of this matter as the suggestion of a high officer of the government who appreciated not only the direct commercial results of the measure, but also its indirect moral effect:

> There is another side to this which occurs to me. It may appear to many to have a more sentimental than practical value, but it gives the proposition, to my mind, great force, and that is what might be called the moral aspect of this question; that recognition by the government of an absolute standard, to which fidelity in all the relations of life affected by that standard is required. We are the victims of looseness in our methods; of too much looseness in our ideas; of too much of that sort of spirit, born out of our rapid development, perhaps, of a disregard or a lack of comprehension of the binding sanction of accuracy in every relation of life.
>
> Now, the establishment of a bureau like this, where the government is the custodian and the originator of these standards of weights and measures as applied to all the higher scientific aspects of life which we are so rapidly developing in, has, to my mind, a value far and above the mere physical considerations which affect it, although those physical considerations are fundamental and most important. Nothing can dignify this government more than to be the patron of and the establisher of absolutely correct scientific standards and such legislation as will hold our people to faithfully regard and absolutely obey the requirements of law in adhesion to those true and correct standards.

The bill for the establishment of the bureau received at the hands of the Committee on Coinage, Weights and Measures a consideration seldom given to such a measure, and when it was finally reported it received from that committee on the floor of the House a support which indicated their appreciation of its importance and value. In particular the names of the chairman of the committee, Hon. James H. Southard, of Ohio; and Hon. John F. Shafroth, of Colorado, deserve special mention. In the closing days of the fifty-sixth congress, when it was doubtful whether the speaker could permit consideration of the measure, Mr. Southard kept his seat day after day, and even night after night, in order that no opportunity might slip by when the speaker might be able to recognize him for the passage of the bill. In the splendid new building which Congress has provided for the housing of this bureau, and which is to become in the future the home of the great influence which it will exert on science and on industry, two names of those who had to do with its successful inception, so far as legislation is concerned, may well be placed high on its walls; and these are the names of Lyman J. Gage, Secretary of the Treasury, and James H. Southard, Chairman of the Committee on Coinage, Weights and Measures.

In the Senate, also, the bill received friendly consideration at the hands of the Committee on Commerce.

Looking back over the history of this legislation, which was effected without the help of any lobby, at the recommendation of a few men qualified to speak on such matters, it is evident that it has been the result, in the first place, of the work of those who founded the Office of Weights and Measures; of the influence of the scientific recommendations of the last twenty years looking toward the enlargement of that bureau, and of the intelligent interest of the Secretary of the Treasury and of the Chairman of the Committee on Coinage, Weights and Measures. And finally, but by no means least in importance, the successful outcome is due to the intelligent way in which this bill was placed by Mr. Stratton before the committees in the House and in the Senate. The enactment of such a measure ought to reassure scientific men in their judgment of the relation of Congress to legislation in such matters, since it shows that such legislation can be had without the help of any lobby, without the stimulus of personal interest on the part of Congress, if there is presented a clear and satisfactory reason for such legislation by those in whom Congressmen themselves have confidence.

Another feature of this bureau, which is unique, will also be watched by scientific men, as time goes on, with great interest, and that is the provision under which a visiting committee of five men, not connected with government service, report each year on the efficiency and needs of the bureau. I shall be greatly disappointed if this does not have a wholesome effect on the bureau itself, and on the relations of the bureau with Congress and with the department. It is scarcely possible that a Secretary of the Treasury will dismiss from office a competent head of the bureau who is supported courageously by this committee, nor will he appoint to the office of director a man whom they consider incompetent and unsuitable. If out of this relation there comes a wholesome criticism and a quickening of the scientific spirit, one may well hope that this feature may find a place in other departments of government scientific work.

Henry S. Pritchett.

THE ASTRONOMICAL AND ASTROPHYSICAL SOCIETY OF AMERICA.

II.

The Constant of Aberration: C. L. Doolittle.

For some time a revision of the latitude work carried on at the Sayre Observatory, Bethlehem, Pa., from 1876 to 1895, has been in progress with the view to its publication in a complete and final form. The first fasciculus of this publication appeared in the spring of 1901 and it is hoped that the remainder may be in form for the printer in the course of two or three months.

The present communication deals primarily with the value of the constant of aberration resulting from the series of observations extending from October 10, 1892, to December 27, 1893. A preliminary solution of the problem was published in the *Ast. Journal,* No. 406, 1897, which may be consulted for a fuller statement as to the method employed. The micrometer screw had become much worn by constant use for several years and the value was not constant throughout the series. Also the progressive errors which had been previously determined by means of Harkness' measuring engine were no longer applicable. It seemed very desirable that the screw value should be derived from the latitude observations themselves, but at the time spoken of the star declinations were not known with the requisite precision. For these reasons there was some hesitation as to the desirability of publishing the preliminary result, as it was thought possible that a considerable error might be involved. Recently a very careful discussion of the declinations has furnished the required data, and a result obtained which seems entirely free from the above named objections.

From the method of observing it is not possible to separate the correction to the aberration constant from the latitude variation without introducing an assumption with respect to one or the other. It has accordingly been assumed that the latitude variation can be represented by two periodic terms of 14 and 12 months, respectively. Each observed latitude, therefore, gives an equation of this form

$$x \sin N + y \cos N + z \sin \odot + u \cos \odot + E_\rho + T\mu + \Delta\phi + \phi_0 = \phi$$

where N is the 14-month term, E_ρ the correction to the aberration and T_μ secular change in the latitude.

The evening and morning observations furnish 1,744 and 1,052 equations of this form, respectively. These were solved retaining all terms. Then another solution was made excluding the annual term, as it is obvious that this can not be separated from the 14-month term in a series embracing a period of less than 16 months. The resulting value of the constant of aberration from both the preliminary and revised solution is as follows:

	Preliminary.	Revised Solution.
1st solution,	20″.552 ± .0095	20″.551 ± .0092
2d "	20 .555 ± .0093	20 .552 ± .0090

It thus appears that the suspected error in the preliminary reduction was a vanishing quantity.

Two other series of observations made at the Sayre Observatory have been employed for a similar investigation. The first, from December 1, 1889, to December 13, 1890, embracing 1,344 latitude determinations, was treated in a manner similar to that above described except that only one solution was made involving periodic term of 14 months. The resulting aberration constant is 20″.448 ± .014. It is doubtful whether this result is entitled to much confidence, the most serious objection being that the series does not cover a full term of 14 months, which is assumed for the period of latitude variation. The other series referred to extends from January 19, 1894, to August 19, 1895, the arrangement being that sometimes called the polygon method by which the aberration is obtained independently of the latitude variation. The result is 20″.537. Other recent determinations are given for comparison:

Flower Observatory.

1896–98	20″.580
1898–99	20 .542
1900–01	20 .560

J. W. J. A. Stein, Leiden—Zenith Telescope.

1899–1900	20″.541 ± .016

Albrecht—International Latitude.

20″.515

Chandler from Pond's Observations.

1825–36	20″.512 ± .019

The Period of Delta Equulei: W. J. HUSSEY.

Delta Equulei enjoys the distinction of having a period shorter by nearly half than that of any other visual double star and in being at the same time a spectroscopic binary. The latter characteristic is due to the visible components. It therefore forms a connection between the visual and spectroscopic double stars. This pair was discovered in 1852 by Otto Struve and observed by him occasionally for thirty years. Burnham's observations from 1880 to 1883, inclusive, appeared to indicate a period of 10.8 years; the elements subsequently derived by Wroublewsky and by See gave nearly 11.5 years. Between 1899.85 and 1900.65 the components rapidly approached each other and the apparent distance was extremely small at the latter date. This rapid change in distance is not explainable on the hypothesis that the period is nearly 11.5 years, but is entirely in accord with one of about half this length. The elements derived by the writer a year ago have a period of 5.7 years. From these elements he predicted that the components should separate to a measurable distance this year and again close in. Observations show that this has happened. In July, 1901, the distance was approximately 0″.15. It has now decreased to less than 0″.05, or approximately the same as in the autumn of 1900. The data at present available appear to show that the period of 5.7 years is substantially correct.

The Duration of Twilight within the Tropics: S. I. Bailey.

The atmosphere renders many services to man. Not the least of these, perhaps, is the twilight. If there were no atmosphere, there would be no twilight, and the brightness of midday would be succeeded, the moment after sunset, by the darkness of midnight. Such a condition of affairs would cause considerable inconvenience. Twilight may be said to last until the last bit of illuminated sky disappears from the western horizon. In general it has been found that this occurs when the sun has sunk about 18° below the horizon. The duration of time which the sun takes in reaching this position is very different at different latitudes. At the North Pole one would have about six months of daylight, followed by nearly two months of decreasing twilight, followed in turn by more than two months of night. In summer, at latitudes greater than 50°, twilight lasts from sunset to sunrise. There is no night there, during this season. In the temperate zones the duration of twilight ranges from an hour and a half to more than two hours. Within the tropics the sun descends nearly or quite vertically; but even here the time required for the sun to reach a point 18° below the horizon is more than an hour. There seems to be no reason, therefore, in the general theory, for the widespread belief that the duration of the tropical twilight is extremely brief. This idea is found not only in current popular literature, but also in some of the best text-books on general astronomy. Young's 'General Astronomy,' p. 69, says: "At Quito and Lima it (the twilight) is said to last not more than twenty minutes." Why Quito should be classed with Lima I do not know, except that both are within the tropics. 'The Heavens Above,' by Gilbert and Rolfe, remarks: "Within the tropics, where the air is pure and dry, twilight sometimes lasts only fifteen minutes." Since Arequipa, Peru, lies within the tropics and has an elevation of 8,000 feet, and the air is especially pure and dry, the conditions appear to be exceptionally favorable for an extremely short twilight. On Sunday, June 25, 1899, the following observations were made at the Harvard Astronomical Station, which is situated there: The sun disappeared at 5:30 P.M., local mean time. At 6:00 P.M., 30 m. after sunset, I could read ordinary print with perfect ease. At 6:30 P.M. I could see the time readily by an ordinary watch. At 6:40 P.M., 70 m. after sunset, the illuminated western sky was still bright enough to cast a faint shadow of an opaque body on a white surface. At 6:50 P.M. the illumination was faint, and at 6:55 P.M., 1 h. and 25 m. after sunset, it had disappeared. On August 27, 1899, the following observations were made at Vincocaya. The latitude of this place is about 16° south, and the altitude 14,360 feet. Here it was possible to read coarse print 47 m. after sunset, and twilight could be seen for an hour and twelve minutes after the sun's disappearance. It appears, therefore, that while the tropical twilight is somewhat shorter than occurs elsewhere, and is still further lessened by favorable conditions, such as great altitude, and a specially pure air, it is never less, and generally much longer, than an hour.

The Determination of Double Star Orbits: George C. Comstock.

The usual data for the determination of

a double star orbit consist of a series of observed position angles and distances with the corresponding times of observation. From this data it is customary to derive the apparent orbit of the star by plotting the observed coordinates and drawing through the resulting points the best ellipse that can be fitted to them, subject to the condition that in this ellipse the radius vector must sweep over equal areas in equal times. The author knows no published statement showing how this condition is applied in the actual construction of the ellipse and it is not apparent how it can be applied in any satisfactory manner in this purely graphical process. Moreover, the process is open to the additional objection that it takes small account of the circumstance that of the three elements entering into a complete double star observation, position angle, distance and epoch, the time of observation is determined with a precision incomparably superior to that of the measured coordinates, and should therefore play a prominent part in the determination of the orbit instead of the subordinate rôle commonly assigned it. The method proposed for improving the current practice in these respects reverts to the practice introduced by Sir John Herschel, of plotting the observed position angles with the corresponding times as abscissæ, and extends the same practice to the observed distances. From the resulting curves data are derived for assumed epochs, and through a least square adjustment supplemented by mechanical quadratures are transformed into normal places that satisfy rigorously the condition of constant areal velocity. A partial control upon the character of the data and the treatment to which they have been subjected is furnished by the quasi rigorous condition that the adjusted normal places shall all lie upon some ellipse. In the adjustment of the data there is incidentally determined the areal velocity of the radius vector and this in connection with the apparent orbit, plotted from the normal places, leads immediately to a determination of the periodic time and to the independent determination of the dates of periastron and apastron passage. The agreement of the double interval between these dates with the periodic time first determined furnishes a partial check upon the work. The transition from the apparent to the real orbit may be made by any of the standard methods, but that of Klinkerfues when simplified by the introduction of the elements above derived is especially convenient. There was presented an application of the method above outlined to the determination of the orbit of Struve 2,107, showing that the labor involved does not greatly exceed that of the ordinary methods and is fully compensated by the checks furnished *en route* as well as by the increased precision of the results.

A Cosmic Cycle: FRANK W. VERY.

An application of a new doctrine of an explosive condition of matter (limited by composition, pressure and temperature) to various phenomena of the heavenly bodies, and to stellar evolution. Novæ are regarded as the culmination of long-enduring antecedent stages of stellar preparation, and as indicating (along with the helium stars) a condition of instability and active modification which is incompatible with planetary growth, but which is followed by other relatively quiescent stages favorable to the production of planets and to their orderly development. An extension of the doctrine of the conservation of energy is involved, and the problem of the sustentation of solar heat is approached from a new standpoint which admits of a great extension in the duration of the solar system, thus satisfying the demands of the geologist for a prolonged terrestrial duration. (The paper will appear in full in the *American Journal of Science*.)

A Comparison of Printing and Recording Chronographs: C. S. Howe.

A printing chronograph, to be of any value to astronomers, should be easily set and regulated; it should run several hours without any attention; it should have a small probable error; its results should agree, or differ by a constant amount each night, with the results from the recording chronograph. Several months' experience with the Hough printing chronograph at the Case Observatory shows that the instrument can be easily set and adjusted and that it runs several hours without any attention. The probable error of one record was found to be ± .011 seconds, and the probable error of the mean of nine wires ± .004 seconds. Similar tests with the recording chronograph give respectively ± .006 and ± .002 seconds. These errors are so small that they can be neglected. A direct comparison of the two chronographs showed an average difference between them of .025 seconds, the printing chronograph making the record first.

The Clock Room at the Case Observatory: C. S. Howe and E. H. Brown.

The clock room is a room built of tile within one of the rooms of the basement of the Physical Laboratory. The basement is warmed in the daytime, but not at night. The space outside the clock room is warmed by two gas stoves, the gas being turned on or off by an automatic burner which is regulated by a thermostat made of steel and hard rubber. This controls the temperature outside the clock room within one degree centigrade and inside the clock room within about one half degree. The inside temperature is further controlled by another thermostat, which by means of a relay throws in or out one or more electric lamps, the heat of which changes the temperature. This arrangement keeps the temperature within one tenth of a degree. The hourly rates of a Riefler clock, enclosed in a glass case from which the air is partially exhausted, were also given.

The Almucantar as an Instrument for the Determination of Time: C. S. Howe.

In 1885 Dr. Chandler compared the clock corrections determined with a small almucantar with those determined with the large Transit Circle of the Harvard Observatory. The Case Almucantar is a large instrument with a six-inch object glass. It was not possible to compare it with a large transit and so its value for the determination of time could only be determined by the consistency of the several results obtained on any one night and by the excellent and nearly uniform clock rates determined by it. The differences between the several values of the clock corrections on any one night were usually not more than two or three hundredths of a second and the greatest difference since June, 1901, was 0.13 of a second.

A Description of the Second (Chile) Mills Spectrograph: W. W. Campbell.

The mechanical features of the instrument and its method of support are radically different from those of the conventional spectrographs. The entire framework is composed of a single steel casting with webs and flanges bracing it thoroughly in every direction and with especial reference to the supports near its two ends. The slit, the prism box, the camera and the collimator and camera lenses are all fixed directly to the casting. A reflecting slit is used, curved to make the spectrum lines straight. The weight of the entire spectrograph is about 75 pounds. The instrument is mounted in a supporting cradle composed of tee and channel steel bars in such a way that it will rest on two points (a plane and a ring) near the two ends of the instrument, respectively. Strains in the supporting cradle cannot induce strains in the spectrograph. The old method of supporting spectrographs entirely from one end, allowing the other end to project unsupported out into space, invites flexure effects, and it is hoped that the new method of support will prove to be a radical improvement. The whole spectrograph will be moved to bring the slit into the focus of the Cassegrain telescope. A temperature case similar to the one used for the past three years on the original Mills spectrograph will enclose the instrument.

On the Capture of Comets by Jupiter: PERCIVAL LOWELL.

This paper gave in diagrams a part of the author's memoir on the subject, not yet published, in which he explained the action of Jupiter upon a comet entering the planet's sphere of activity, and the relation borne by the direction and the speed of approach to the comet's subsequent behavior. The paper showed that Jupiter was not only capable of transforming at one encounter a parabolic comet into an elliptic one of about half his own major axis, but could actually cause a comet to make the planet instead of the sun the goal of its visit, and send it back again into space without circumnavigating the sun at all. The argument then developed a critical angle differentiating those comets which Jupiter's action might render retrograde from such as it could not. A table here showed that the angle of approach of each of the comets composing Jupiter's comet family not only at the present moment fell within the critical angle for each, but must do so for all time, abstraction made of perturbations by other bodies and the approximation being of the first order. In other words, that under these conditions the present direct motion of all the members of Jupiter's comet family was such in perpetuity. The planet might drive them off into space but could never render any of them retrograde.

The Latitude-Variation Observatory of the International Geodetic Association: HERMAN S. DAVIS.

A brief statement of the plan of the International Association in the establishment of the four stations at Gaithersburg, Maryland, Ukiah, California, and in Japan and Sardinia for a systematic and continuous series of observations for the study of variations of latitude. Particular attention was given to the two stations in the United States under the general direction of the Coast and Geodetic Survey, the one in charge of Dr. Schlesinger, at Ukiah, and the other in charge of the speaker, at Gaithersburg. Illustrations with the lantern were shown of both these stations with plans of the buildings and views of the telescope at Gaithersburg. Attention was called to the admirable quality of the observations made by Mr. Edwin Smith, who was in charge of the station at Gaithersburg prior to January, 1901, and entire credit given him for the erection of the buildings and installation of the instruments at this station, and to the active and enthusiastic support of the superintendent of the Coast Survey from the very inception of the plan to establish these stations in the United States.

Some Vices and Devices in Astronomical Computations: HERMAN S. DAVIS.

Owing to the briefness of the time requested for the presentation of this paper and the fact that a considerable portion of that time was devoted to the preceding paper which was presented by request—not being regularly on the program—the speaker gave only a meager description of some of the methods which he is now using in the new reduction of the 160,000 star-observations made by Piazzi at Palermo between 1792 and 1813. Particular attention was directed to only one of the many devices which have been applied for shortening the computations whereby already the work is two years ahead of the schedule outlined at the beginning of the undertaking, that device being the use of specially constructed table of limiting-values instead of such logarithm or anti-logarithm or other tables as appear in print. Illustrations of these special tables and their application and data as to the percentage of time saved by their use were also given. Another one of the devices has already been published in *Astronomical Journal*, No. 498 (XXI.:143–4), and a number of others, of which mention was omitted for lack of time and the lantern slides which had been designed (but unexpectedly delayed) for their proper exposition will be put into print at some future date.

Observations of Meteors, November 13–16, 1901: J. K. Rees.

As in previous years, I observed with Mr. Charles A. Post from his observatory at Bayport, Long Island. We arranged (1) to photograph meteor trails with four cameras mounted on the equatorial which was driven by an excellent clock, (2) to count the meteors and (3) to record individual meteors which exhibited striking peculiarities.

1. The equatorial and cameras employed are shown in Plate II., *Popular Astronomy* (No. 82), February, 1901.

The apertures and focal lengths are given in the following table:

Instrument.	Aperture.	Focal length.
Equatorial telescope.	6 inches.	90 inches.
Willard photographic doublet.	5½ "	23 "
Darlot portrait.	1½ "	6½ "
Anthony portrait.	3 "	13½ "
Goerz wide angle double anastigmatic.	1½ "	9½ "

PHOTOGRAPHIC EXPOSURES.

Nov. 13. 12:00 to 18:00 (Eastern Standard time). A number of experimental plates were taken but no effort was made to photograph meteors, as so few were seen.

Nov. 14. 11:20 to 12:24. Exposed the Goerz lens pointed at the belt of Orion. 13:15 to 14:05. Exposed all the cameras pointed as follows: Willard and Anthony lenses at Procyon, Goerz lens at belt of Orion, and Darlot lens at μ and ε Leonis. At 15:00 the sky clouded but cleared again at 15:30. 15:42 to 16:30 all cameras were exposed. The Willard and Anthony on ε Leonis, the Goerz on ζ, ε, δ Hydræ, and the Darlot on Ursa Major.

The clouds began to spread over the sky again, and in a short time it was impossible to see a star, later it cleared. Observers then confined their attention to counting and observing the meteors.

Nov. 15. 11:45 to 13:00. Exposed all cameras. Willard and Anthony lenses on Pollux, Goerz lens on Procyon, and Darlot lens on γ Geminorum. 14:35 to 15:45. Exposed all cameras. Willard and Anthony on ζ Leonis, Goerz on Regulus, and Darlot on λ and μ Leonis Minoris. Clock did not work as well as usual. 16:01 to 17:00. Willard lens was omitted. The other cameras were pointed as in the preceding exposure.

Mr. Post developed all the plates. The plates taken on November 14 show a number of trails. Quite a remarkable meteor trail is shown on the plates taken with the Willard and the Anthony lenses between 15:42 and 16:30. The notes given under 'Record of Individual Meteors' seem to show that this meteor appeared at 15:58.

2. Count of Meteors.

Only during the night of November 14 was any careful attempt made to count. Miss Edith Post and Miss Greenough observed the eastern sky looking toward the radiant. At first both observed the same part of the sky, but after 38 had been counted Miss Greenough observed the southeastern sky from the line from the radiant to the zenith, and Miss Post observed the northeastern sky from the same line. The count was as follows:

Nov. 14. 12:15 to 13:40. Miss Post and Miss Greenough, 38; Miss Post—northeastern sky, 31; Miss Greenough—southeastern sky, 31. 13:40 to 14:20. Messrs. Post and Rees looking out of the opening in the roof of the Observatory toward the radiant, 20. 14:20 to 15:00. Miss Post—northeastern sky, 10; Miss Greenough, southeastern sky, 15. 15:50 to 17:55. The Misses Post and Greenough counted being assisted from 16:30 to 17:55 by Post and Rees. The total count of the four observers was 273. Total for the evening, 418.

Nov. 15. Post and Rees assisted by Mr. Post's 'handy man' counted, while engaged on the photographic work and looking out of the observatory opening, as follows: 11:45 to 13:00. 25, several of which were non-Leonids. 14:35 to 15:45. 3 of which 1 non-Leonid. 16:01 to 17:00. 23, several non-Leonids.

Nov. 16. 12:00 to 17:00. Looked out frequently but saw so few that no record was kept.

3. Individual Meteors.

Nov. 14. 11:30. Two bright Leonids—trails yellow-red 10° long—width very distinct. 11:51. Leonid from Procyon to θ Orionis—blue streak. 12:07. From star above Procyon to 'yardstick'—trail 25° long—lasted several seconds—yellow—Leonid. 12:10. Leonid through Ursa Major—bright trail. 12:15. Leonid through Ursa Major. 12:17. Leonid through Auriga. 13:18. Brilliant Leonid, near radiant—very small trail—orange color—bright as Mars at best. 13:27. Fine Leonid from Leo to zenith—trail 30° long—yellow-red. 13:30. Leonid through Ursa Major—fine. 13:40. Meteor near Procyon—from zenith down—short trail. 13:44. Fine Leonid through bowl of dipper—trail 5°. 13:51. Leonid under Procyon—8° trail—yellow-red. 15:58. Brilliant Leonid—trail 5°—lasted twenty seconds—blue-white—1st magnitude. 16:04. Leonid under Procyon—blue-white—10° trail. 17:28. Two brilliant meteors visible at same time—trails crossed—bright heads. One came from radiant and passed near a and β Can. Ven.—trail 30° long and lasted several seconds. The second seemed to come from below β Leonis and cut the trail of the first under Canes Venatici—trail 30°. Magnitude of each—2.

Nov. 15. 14:52. Bright Leonid under Leo Minor. 15:37. Leonid bright as Jupiter—in sickle—blue and red trail. About 15:55. Fire ball below Leo came from Orion. 16:10. From zenith through Leo Minor (λ and μ)—long train 40°. About 17:00. The zodiacal light showed itself in a grandly beautiful manner.

A Theorem concerning the Method of Least Squares: HAROLD JACOBY.

The following theorem and conclusion are doubtless well known to many astronomers, but the writer has not found an explicit statement of them in print. Let there be given two series of observation equations as follows:

$$\left.\begin{array}{l} a_1x + b_1y + c_1z + \cdots + n_1 = 0 \\ a_2x + b_2y + c_2z + \cdots + n_2 = 0 \\ \quad\vdots \qquad\qquad \vdots \end{array}\right\} \quad (1)$$

$$\left.\begin{array}{l} a_1x + b_1y + c_1z + \cdots + p_1w + \cdots + n_1 = 0 \\ a_2x + b_2y + c_2z + \cdots + p_2w + \cdots + n_2 = 0 \\ \quad\vdots \qquad\qquad \vdots \end{array}\right\} \quad (2)$$

the equations being identical in the two series except for the addition of one or more new unknowns, $w, \ldots$ in (2). Let each series of equations be solved by the method of least squares, and let $[vv]_1$ be the sum of the squares of the residuals resulting from the solution of equations (1), $[vv]_2$ be the sum of the squares of the residuals resulting from the solution of equations (2); then, no matter what may be the law of the coefficients $p_1, p_2, \ldots$, and even if these coefficients are assigned at random, $[vv]_1$ is always larger than $[vv]_2$.

Corollary.—The theorem can be extended easily to an additional case of equal importance. Instead of introducing the new unknowns $w, \ldots$, by adding them to those already occurring in equations (1), we may select out certain equations from the series (1), and simply substitute new unknowns, like w, for old ones, like z, leaving the coefficients unchanged.

Conclusion.—The method of least squares is used ordinarily to adjust series of observation equations so as to obtain the most probable values of the unknowns. But there is a subtler and perhaps more important use of the method; when it is employed to decide which of two hypothetical theories has the greater probability of really being a law of nature; or to decide between two methods of reducing observations. Cases abound in astronomy where the method of least squares is used for this purpose. It has been so employed, for instance, to decide whether stellar parallax observations should be reduced with equations involving terms depending on atmospheric dispersion, and terms depending on the hour-angle, to ascertain whether portable transit observations should be reduced on the supposition of a change of azimuth on reversal of the instrument (an application of the corollary), etc.

In such cases, astronomers not infrequently give preference to the solution which brings out the smallest value of $[vv]$, the sum of the squared residuals. But in the light of the above theorem, it becomes clear that the mere diminution of $[vv]$, alone is insufficient to decide between two solutions, when one involves more unknowns than the other. To give preference to the second solution it is necessary that the diminution of $[vv]$ be quite large, and that the additional unknowns possess a decided *a priori* probability of having a real existence.

The Nebula about Nova Persei, 1901: FRANK W. VERY.

The rapidly shifting and fast fading nebulosity around the new star is regarded as an evanescent phenomenon comparable to the tail of a comet. Velocities of propagation of different orders are surmised, but as there is no known motion of material particles, even when of the dimensions of negative ions, swifter than that of light, the latter may be taken as a limiting value of velocity, from which it is deduced that the distance of the nova can not exceed 750,000,000,000,000 miles, an estimate which gives us a first approximation to the distance of the Milky Way, since the novæ all belong to the galactic stream. An explanation of the meaning of the complex structure of the hydrogen bands in the spectrum of the nova is given, and a further cometary analogy is shown through the existence of concentric spherical envelopes near the star, resembling comæ, which are inferred from the structure of the spectral bands. From the spectral variations attending the formation and motion of these envelopes, the mass of the star is concluded to be about 1,150 times that of the sun; and as this mass does not appear to have been appreciably changed in the first month, in spite of the enormous outpourings of hot gases, it follows that the luminosity of the star is not conditioned by the mass or by the state of the star's internal activity; and it is suggested that the brightness of the star's continuous spectrum depends upon the formation or dissolution of clouds of cosmic dust in the spaces immediately surrounding the nova.

A Short and General Method of Determining Orbits from Three Observations: A. O. LEUSCHNER.

The method is principally intended to aid in the rapid determination of an orbit from three observations, made at short intervals. It is essentially an improvement on Harzer's modification of Laplace's method contained in Méc. cél. T. I., première partie, livre II., Chap. IV. The first part of the paper deals with the discussion or Harzer's method. The modifications introduced by the author consist in: (1) The restriction of the number of observations to three, the minimum number necessary for the solution of the problem. (2) The reduction of the number of fundamental data to be approximated. In Harzer's method the fundamental data to be approximated are the heliocentric coordinates and their velocities, while in the present method they are the geocentric distance and the velocities of the heliocentric coordinates, all for the zero date. (3) A short method of obtaining preliminary values of the geocentric velocities and accelerations at the zero date. (4) A direct solution of the fundamental equation of the seventh degree in ρ_0, on the basis of von Oppolzer's table XIIIa ('Bahnbestimmung,' Vol. I.). (5) Differential formulæ for the determination of the final values of the heliocentric coordinates and velocities from which the elements are computed by Encke's formulæ. Chief among the advantages of the method here outlined are the ease with which such corrections to ρ_0, x_0', y_0', z_0' may be determined as will cause the residuals due to the original values of these quantities to disappear, and the possibility of determining these corrections directly from the residuals. On that account, it is of no great consequence if the originally adopted velocities and accelerations in α and δ are only approximate.

Elements of Asteroid 1900 GA and its Ephemeris for the Opposition of 1901–1902: A. O. LEUSCHNER and ADELAIDE M. HOBE.

This asteroid was discovered June 28, 1900, by the late director, James E. Keeler, of Lick Observatory, while photographing the region of the sky near Saturn with the Crossley Reflector. Trails were photographed on four days and point-images on two of these days. The problem of determining the orbit of the asteroid presents many points of interest and has led to the derivation of the 'Short and General Method of Determining Orbits from Three Observations.' The existing methods for determining orbits could not be used to advantage in this case, but the solution was successfully accomplished by means of the 'Short and General Method of Determining Orbits from Three Observations' outlined above. The magnitude of the asteroid at the present opposition (1902, Jan. 4) is $19.5 \pm .75$. The asteroid is, therefore, the faintest so far observed. The paper concludes with the discussion of the residuals of the measured positions of the termini of the trails relatively to the middle of the trails.

Discovery of Motion in the Faint Nebula Surrounding Nova Persei: C. D. PERRINE.

Early in the apparition of the new star in Perseus, short exposure photographs of it were secured with the Crossley Reflector by Messrs. H. K. Palmer and C. G. Dall. The first long exposure was secured on the nights of November 7 and 8. This negative had a total exposure of 7 h. 19 m. It was developed on the 9th, but owing to stormy weather was not dry and was not carefully examined until the morning of the 10th, when it was compared with the reproduction of a negative taken at the Yerkes Observatory on September 20 by Mr. Ritchey and published in the October number of the *Astrophysical Journal,* and the discovery at once made that several of the principal condensations in the nebula had moved to the southeast over a minute of arc in the interval. The main facts were embodied in a telegram which was sent to the Harvard College Observatory, for distribution to all observatories, at noon of November 10. A negative was obtained on the nights of November 12 and 13 with a total exposure of ten hours. A more rapid plate was used than on November 7 and 8 and with the longer exposure considerably more detail is shown. An exposure of 5 h. 28 m. was obtained on the night of December 4. As a storm came on, this plate was developed the following day. Considerable detail was shown on the negative and three of the condensations were seen to have moved appreciably, while the strong one nearest the Nova showed but little if any change. An exposure of ten hours was secured on the nights of December 8 and 11, the 9th and 10th being cloudy. The motion of the nebula is so rapid that even in this interval of three days, blurring in the best-marked condensation is noticeable. A comparison of the last negative with that of November 12 and 13 reveals a number of changes. Condensations *A*, *B* and *C* (Lick Observatory Bulletin No. 10) have each continued their motions to the southeast full ½′. Condensation *D* shows little or no change. Perhaps it is moving nearly in the line of sight. The negatives of December 4 and 8–11 show two new wisps of nebulosity southwest of the Nova at distances of 13′ and 14′, respectively. They are approximately arcs of circles of which Nova is the center and are about 2′ in length. They have been carefully looked for on the November negatives, but no traces are there found of them. Throughout the entire southeast quadrant faint nebulosity is shown to a distance of 18′ on the negative of December 8–11. There is but little appearance of structure in this outlying nebulosity. Several wisps of nebulosity 6′ to the north of Nova are sufficiently strong to show that motions outward of ¼′ to ½′ have taken place in the interval of 27 days. A wisp 9′ to the north has also moved outward full ½′. 6′ to the northwest of Nova is a wisp which has moved outward ¼′. None of these wisps to the north and northwest are well enough defined lengthwise to make the other component of motion certain in the interval. Directly to the west is an arrow-shaped mass of nebulosity resembling somewhat the structure of condensation *A*. It has certainly moved outward and there appears to have been a motion to the northwest. Many changes of form and intensity of masses of nebulosity have been noticed other than those referred to above, but which can not well be described. A longer series of photographs is necessary to deduce the character and amount of motion of these fainter masses. Lantern slides of the various photographs secured with the Crossley reflector were exhibited.

A Determination of the Wave Lengths of the Brighter Nebular Lines: W. H. Wright.

In the progress of our investigations upon the spectrum of Nova Persei (see Lick Observatory Bulletin No. 8) there arose the necessity for a more accurate knowledge than then existed of the wave lengths of the Brighter Nebular lines. The spectra of the Orion Nebula and of three of the brighter planetary nebulæ have been photographed in some cases with one prism, and in other cases with three prisms, and the resulting plates have been measured and reduced. The wave lengths of 16 bright lines have been determined with considerable accuracy, the fifth significant figure being determined definitely for the principal ones, and the uncertainty in the sixth place for the brighter lines being comparatively small. A slight correction appears to be needed in the values at present accepted for the positions of the two chief nebular lines determined by visual means. In the course of the work three new nebular lines have been discovered. The well-known lines usually described as H_ϵ and λ 3,727 have been found to be double.

A Determination of the Cause of the Discrepancy between Measures of Spectrograms made with Violet to Left and with Violet to Right: H. M. Reese.

In this paper three possible causes of the effect in question are investigated: (1) The curvature of the spectral lines; (2) the position of the star-spectrum in the middle of the plate, enclosed by the comparison-spectrum; (3) a mere subjective tendency to set the cross-hair relatively farther to the right on a dark line in a white field than on a bright line in a dark field. The conclusion is reached that the third cause alone really operates, or at least that neither the curvature of the lines nor the relative position of star-spectrum and comparison affect the case.

Four New Spectroscopic Binaries: W. W. CAMPBELL.

Four stars have recently been observed with the Mills spectrograph to have variable velocities in the line of sight. These are φ Persei, ξ Herculis, α Equulei and υ Andromedæ. The first of these is an interesting bright-line star. The second has a large radial velocity, and is moreover an interesting visual double star whose period is about 33 years. This therefore affords another connection between visual and spectroscopic binaries. In the case of the third star, a composite spectrum was observed a few years ago by Miss Maury at Harvard College Observatory. Thirty-two spectroscopic binaries discovered with the Mills spectrograph in the past three years had previously been announced, thus bringing the number up to 36. On the list of suspected binaries are 14 stars, awaiting confirmation. Before the discovery of these binaries, 3 had been found in the same list of stars by Belopolsky, making about 40 spectroscopic binaries in 325 stars observed. The proportion is therefore one spectroscopic binary for every eight stars observed. The variable velocity of our sun, due to its revolving planets, has a double amplitude of only a few hundredths of a kilometer. As the work progresses and the degree of accuracy attainable increases, we shall probably find that there is a regular gradation of double amplitudes from that of our sun up to those of the spectroscopic binaries already discovered, and it is possible that the star that is not a spectroscopic binary will prove to be the rare exception. This field of investigation is one of extreme richness.

Discovery of Five Hundred New Double Stars: W. J. HUSSEY.

While observing the Otto Struve double stars the writer discovered new companions to five of them and also picked up several new pairs in the vicinity of others. This led to the notion of making an extended search for new pairs, which was begun as soon as it was possible to do so without interfering with the work in progress. In the spring of 1899 search was commenced in a tentative way and in July of the same year it was taken up regularly, and since then has been conducted in a systematic manner. While only a part of the writer's time has been devoted to the consideration of new double stars, he has now discovered and measured five hundred new pairs having distances under five seconds. The work has been done with both the twelve- and thirty-six-inch telescopes of the Lick Observatory. Many close and difficult pairs, some of them having distances less than a quarter of a second, have been found with the smaller instrument, but nearly all the measures have been made with the great telescope. The classification of the new pairs with respect to the distances between their components is as follows:

0″.25 or less,	37 pairs,
0 .26 to 0″.50,	96 pairs,
0 .51 to 1 .00,	112 pairs,
1 .01 to 2 .00,	112 pairs,
2 .01 to 5 .00,	143 pairs.

Seventy-one per cent. of the total number have distances under two seconds; 49 per cent. under one second; 27 per cent. under half a second; and seven and one-half per cent. under quarter of a second.

On the Discovery of 300 Double Stars: R. G. Aitken.

The writer's experience in observing double stars led him to conclude that it was desirable to make a systematic search for new pairs. As a contribution toward such a piece of work, 10,917 stars brighter than 9.1 magnitude have been examined by him since April, 1899, with the result that 301 new double stars have been found. These all have distances between their components of less than 5″.00, 217 or 72 per cent. being closer than 2″.00, and 19 closer than 0″.25. The search has been made mainly with the 12-inch telescope. The zones examined also contain 530 stars previously catalogued as double, but only 308 of these pairs are comparable with the new pairs with respect to the angular separation of their components. A new double star has been found for every 36 stars examined and one star in every 18 examined is double within the adopted limit. On this basis it is estimated that more than 3,000 close double stars, within the reach of the telescopes of the Lick Observatory, still await discovery.

A Kinematic Study of Hansen's Ideal Coordinates: Kurt Laves.

In the 'Auseinandersetzung' of Hansen the ideal coordinates are defined by the equations

$$\begin{aligned} X\frac{d\alpha}{dt} + Y\frac{d\beta}{dt} + Z\frac{d\gamma}{dt} &= 0 \\ X\frac{d\alpha'}{dt} + Y\frac{d\beta'}{dt} + Z\frac{d\gamma'}{dt} &= 0 \\ X\frac{d\alpha''}{dt} + Y\frac{d\beta''}{dt} + Z\frac{d\gamma''}{dt} &= 0 \end{aligned} \qquad (1)$$

$\alpha, \beta, \gamma, \cdots \gamma''$ are functions of the time, the fixed coordinates xyz are connected with the movable coordinates X, Y, Z by means of the equations

$$\begin{aligned} x &= \alpha X + \beta Y + \gamma Z \\ y &= \alpha' X + \beta' y + \gamma' Z \\ z &= \alpha'' X + \beta'' Y + \gamma'' Z. \end{aligned} \qquad (2)$$

Hansen joins to the conditions (1) the condition:

$$Z = 0 \qquad (3)$$

and obtains a well-defined system of ideal coordinates. Hansen has shown that the three homogeneous equations (1) lead to the following theorem: "In every ideal system of coordinates, referred to movable axes, the instantaneous axis of rotation coincides with the radius vector, drawn to the point." It is the intention of this paper to show that the last condition (3) will give rise to a kinematic theorem of similar import. Indeed, when we consider the three vectors, (1) the vector A of absolute acceleration of the point, (2) the vector of $A^{(r)}$ of relative acceleration of the point and (3) the vector $A^{(s)}$ of the acceleration of the movable system, we obtain for their components along the fixed axis three equations, of which only one is written down:

$$A_x = A_x^{(r)} + 2\left(\frac{dX}{dt}\cdot\frac{d\alpha}{dt} + \frac{dY}{dt}\cdot\frac{d\beta}{dt} + \frac{dZ}{dt}\cdot\frac{d\gamma}{dt}\right) + A_x^{(s)} \qquad (4)$$

Calling the middle terms on the right sides

$$R_x, \quad R_y, \quad R_z$$

respectively, and projecting them upon the movable axis, we obtain

$$\begin{aligned} R_X &= -\frac{dY}{dt}\cdot r + \frac{dZ}{dt}\cdot q \\ R_Y &= -\frac{dZ}{dt}\cdot p + \frac{dX}{dt}\cdot r \\ R_Z &= -\frac{dX}{dt}\cdot q + \frac{dY}{dt}\cdot p \end{aligned} \qquad (5)$$

p, q, r having their usual meaning.

$$R = \sqrt{R_X^2 + R_Y^2 + R_Z^2}$$

will therefore be the moment of

$$\omega = \sqrt{p^2 + q^2 + r^2}$$

with respect to the point, which has for coordinates the quantities

$$\frac{dX}{dt}, \quad \frac{dY}{dt}, \quad \frac{dZ}{dt}.$$

Selecting the position of the XY plane to be that which coincides with the plane of this moment, we have two homogeneous equations of condition, namely,

$$-\frac{dY}{dt}r + \frac{dZ}{dt}\cdot q = 0$$
$$-\frac{dZ}{dt}p + \frac{dX}{dt}\cdot r = 0 \qquad (6)$$

it can be shown that these are equivalent to the one equation $Z=0$. We derive therefore the following: *Theorem.* The condition $Z=0$, which Hansen imposes upon his ideal coordinates, means that he selects for the XY plane the plane of the moment of the vector of instantaneous rotation with respect to the point of coordinates

$$\frac{dX}{dt}, \frac{dY}{dt}.$$

The Computation of Laplace's Coefficients by Means of Gyldén's γ-coefficients: KURT LAVES.

In this paper it is shown, how the quantities $b^{(i)}$ and $c^{(i)}$ can be determined by means of the definite integrals ${}_{s}\beta^{i}$ tabulated by Gyldén in his Hülfstafeln (after multiplication with functions of the argument α). A comparison is made with the table of Runkle, formerly used for this purpose.

Astronomical Photography with the 40-inch Refractor and the Two-foot Reflector of the Yerkes Observatory (Illustrated with lantern slides): G. W. RITCHEY.

The 40-inch refractor, which was designed for visual observations, has been made available for photography through the use of a color screen and isochromatic plates. The greenish-yellow screen, placed in contact with a plate sensitized for light of this color, permits only those rays to pass for which the object glass is corrected. For all but the briefest exposures a double-slide plate-holder is employed. By means of two screws, which move the plate and guiding eye-piece, a star just outside the field being photographed is kept at the intersection of two spider lines throughout the exposure. In this way irregularities in the driving of the telescope, changes in refraction, etc., are corrected. The resulting photographs of the moon, Orion nebula, star clusters, etc., are exceedingly sharp, and are well adapted for measurement on account of their great scale. The two-foot reflector, on account of its short focal length (8 feet) and its freedom from chromatic aberration and absorption, is adapted for a different class of work, in which it admirably supplements the 40-inch refractor. All parts of this reflector were constructed at the Yerkes Observatory. On account of the perfect driving of the clock, permanence of collimation of the large mirror and freedom from flexure in the mounting, photographs of excellent definition are easily obtained. Among those exhibited were the Andromeda nebula, the Orion nebula, nebulæ in the Pleiades, and the expanding nebula surrounding *Nova Persei.*

A Remarkable Disturbance of the Sun's Reversing Layer: GEORGE E. HALE.

A series of photographs of the solar spectrum, taken at the Kenwood Observatory in February, 1894, shows that the reversing layer surrounding a sun-spot was the scene of a great disturbance, which lasted only a few minutes. The diameter of the disturbed area was not less than one-sixth that of the sun. Over this entire region the dark lines of the solar spectrum were for a short time so changed in appearance as to be wholly unrecognizable. Measurements of the photograph show that nearly all of these lines occur in the normal solar spectrum, and that the changed appearance is due to great changes of relative intensity. Thus numerous lines barely visible on Rowland's map were for a short time very intense, while others, such as the aluminium line of intensity 20 at λ 3,961.674, disappeared entirely. Two sharp bright lines appeared at λ 3,884.67 and λ 3,896.21. These were strongest in the spot, and did not extend to the limits of the disturbed area. Full details will be published in the *Astrophysical Journal.*

The Bruce Spectrograph of the Yerkes Observatory: Edwin B. Frost.

The equipment of the Yerkes Observatory has been recently enlarged by the completion of a spectrograph designed for the special purpose of the determination of the motion of the stars in the line of sight. The addition of this instrument to the accessories of the forty-inch telescope was made possible by the liberal gift of $2,300 from Miss Catharine W. Bruce and $500 from the Rumford Fund of the American Academy of Arts and Sciences. The spectrograph is very rigidly constructed, chiefly of iron and steel, and the prisms are maintained in a fixed, invariable position. The whole instrument is inclosed in a large aluminium case with double walls, for protection against changes of temperature. Coils of wire inside this case can be heated by the 110-volt current of the observatory mains, and it has been found not difficult to keep the temperature of the air in the prism-box within 0°.1 C. during exposures of an hour or more. A correcting lens placed one meter in front of the slit makes the visual forty-inch object-glass efficient for the violet light (λ 4,500) which passes through the prism-train at minimum deviation. The collimator is of 2 in. aperture and 38 in. focus; and two cameras are provided, one of 3 in. aperture and 24 in. focus and another, a Zeiss anastigmat, of about 2.8 in. aperture and 18 in. focus. The first three lenses are of triple construction, designed by Professor C. S. Hastings and made by Brashear. It has proved to be a matter of great difficulty to obtain prisms of the large size necessary to transmit a two-inch beam which are sufficiently homogeneous. (The face of the largest prism is 133 mm. long and 57 mm. high.) After an unsuccessful experience with a set of prisms of what appeared to be excellent glass from Mantois, a quantity of glass was ordered from Schott & Co., of Jena, which should be finely annealed and of the quality of telescope objectives, a requirement which, strangely enough, does not appear to be customary in respect to glass for prisms. This new set of prisms shows considerable improvement over the first ones, but the definition is still not the same over the whole surface of the faces. This is now assumed to be due to the moulding of the prisms in trangular shape at Jena instead of melting disks, as we had desired, from which the prisms would be cut by Brashear. Although the spectograph does not fully realize the resolution which the length of the faces of the prisms would imply, the instrument has nevertheless been shown to be capable of furnishing results of a very high degree of accuracy, as illustrated in the paper by an example of a plate of α *Arietis.* The comparison spectra so far employed have been the spark of titanium and of iron and the helium tube. During the exposure on a star the observer guides the telescope by light reflected from the speculum slit jaws, which are not in the same plane, but symmetrically inclined away from the line of collimation, each making with it an angle of 92° 55′. It is also possible, by merely turning a mirror, to observe in the same guiding telescope the light that has gone through the slit and has been reflected at the first surface of the first prism. The method of measuring and reducing the plates briefly described by the writer at the meeting of the Society in 1899 is still in regular use. Plates are measured both with violet to right and with violet to left under the measuring miscroscope, as an observer may have a large systematic difference in his mode of making a setting on the dark lines of the comparison spectrum and the white lines of the stellar spectrum (on the negative). The writer has a large systematic error of this kind, which is reversed in sign but of the same size when the measures are made on a positive copy of the negative. By measuring the plate in both directions this systematic difference appears to be wholly eliminated. Each plate is reduced by itself, independently of any standard plate of a solar or metallic spectrum, with the aid of the Cornu-Hartmann formula in its simple form, the 'fit' of which can be checked up at the position of each comparison line and the wave-lengths corrected accordingly. The first star found by the Bruce spectrograph to be a spectroscopic binary is η Orionis. Four of the first plates, taken by Mr. W. S. Adams and the writer, yield the following velocities:

1901, Nov. 27,	—68	km.	per	second.
Dec. 6,	+13	"	"	"
Dec. 18,	+54	"	"	"
Dec. 19,	—56	"	"	"

The period is not yet determinate. In concluding the paper the proposal was made that the six or seven observatories, which now include in their work the determination of stellar velocities in the line of sight, should cooperate in regularly observing a short list of fundamental velocity stars. The comparison of the results obtained for the same stars with the different spectrographs and different observers, using different sources of comparison spectrum and different lines of the stellar spectra, could hardly fail to be of great value both in indicating causes of error in the separate instruments and in establishing with a high degree of accuracy the velocities of these fundamental stars. (To be published in *The Astrophysical Journal.*)

W. S. EICHELBERGER,
For the Council.

*THE RELATION OF THE AMERICAN SOCIETY OF NATURALISTS TO OTHER SCIENTIFIC SOCIETIES.**

I AGREE in general with all that has been said, and find myself in especially close accord with the remarks of Professor Trelease—so much so, indeed, that I might well refrain from saying more. Yet there are two points in the discussion to which I should like briefly to call attention.

We are all agreed that the object of our meetings is to spread the method and temper of science among the people—to inoculate the community with the spirit of science. Now, while the great central scientific meetings, so well described by Professor Minot, attract the attention of the whole country for a brief time, they do very little and can do very little in extending the influence or the real temper of science. This must be done, if at all, by the teaching, example and lives of those who are devoted to science, scattered through the country and making their influence felt daily throughout the year. It is, therefore, of the utmost importance that the local centers of science, and especially the smaller centers, remain vigorous. By these small centers I do not mean the great universities, or even the smaller colleges. The life of science in institutions of this character does not need the stimulus of meetings. Even at the present time men thoroughly trained in the methods of science are teaching in the normal schools and in the larger high schools throughout our country and the number of such teachers is rapidly increasing. One most im-

* Part of the discussion before the American Society of Naturalists received after the report had been published in the issue of SCIENCE for February 7.—ED.

portant object of scientific meetings is to furnish to these men, most of whom are working singly in their schools and communities, a stimulus to continue the scientific work for which they have been trained, and an opportunity of bringing the results of their study before a sympathetic audience. This opportunity, however, can be afforded only by a local meeting, and any arrangement of meetings which sacrifices the local gathering to the national meeting will have a disastrous effect on the spread of the scientific temper in the country, because it will necessarily weaken these local scientific centers which, from their number, are quite as important as the more conspicuous and stronger centers of science in our great institutions.

I may perhaps be permitted to call attention to a second matter suggested by the discussion, although it is one in which I am not in any way officially interested. I must own that I look with some concern on the change of the American Association for the Advancement of Science from a general gathering to one composed of professional scientists. It has always seemed to me that a most important part of the work of this Association has been in serving as a common ground of meeting for the professional scientists and those who, without professional knowledge, were interested in science. Its meetings have served as an important means of communication between the professional scientific world and the community, reaching the community in the best of all ways—through those individuals who, though without special knowledge of science, have yet a personal interest in it. This function certainly ought to be performed by some organization and it will be of no small concern to science if the American Association decides to abandon this function.

E. A. Birge.

University of Wisconsin.

ALPHEUS HYATT.

Alpheus Hyatt died suddenly of heart disease at Cambridge, Mass., January 15, 1902, a few months before the completion of his sixty-fourth year.

He was born at Washington, D. C., April 5, 1838; prepared for college at the Maryland Military Academy and passed a single year at Yale College. After a year's travel in Europe, he entered the Lawrence Scientific School at Harvard in 1858, graduating with the degree of Bachelor of Science in 1862.

He enlisted in the volunteer militia in 1862, served for nine months, and at the close of the Civil War was mustered out in 1863, as Captain of the 47th Massachusetts Infantry.

Returning to Cambridge, he resumed his studies under the guidance of Professor Louis Agassiz, the greater part of his time being directed to work upon the fossil Cephalopoda. In 1867 Mr. Hyatt went to Salem, Mass., and was associated with Messrs. Putnam, Packard, and Morse in the care of the natural history collections of the Essex Institute, and of the Peabody Academy of Science, and in the editorial management of the *American Naturalist.* He remained in Salem until 1870, when, on May 4, he was elected custodian of the Boston Society of Natural History. By yearly choice Mr. Hyatt remained the scientific head of the Society until his untimely death.

He held professional chairs in Boston University and in the Massachusetts Institute of Technology, and was at one time or another officially connected with the Museum of Comparative Zoology, and the United States Geological Survey.

Professor Hyatt was a member of the National Academy of Sciences (1875), the American Philosophical Society (1895), the American Academy of Arts and Sciences (1869), and of other leading scientific societies both in this country and abroad. In 1898 Brown University conferred upon him the degree of Doctor of Laws.

Professor Hyatt's private life, though uneventful, was attended with many blessings; he had vigorous health, congenial work and many friends. He enjoyed scientific meetings and general society; his welcome to his own home, where he was the most charming of hosts, can never be forgotten. His death, though premature, came as he would have wished, in the fulness of his power and without attendant suffering. As a man of true science he was ready, yet loath, to die.

Professor Hyatt possessed traits of character the worth of which cannot be exaggerated; his kindness towards those working with him was very marked, as was also the purity of his thought and speech; his friendship was sincere and hearty, for while he had, as every man has, his moments of excitement, caused by misunderstandings and differences, one could disagree with him on any or on every vital question with full confidence that such clashes would not weaken his regard. Such an entire absence of all personal feeling must be regarded as a very rare and remarkable trait.

From the outline as given, the life work of Alpheus Hyatt may be grouped in three sections: First, as the head of a museum of natural history; secondly, as a teacher of science; and, thirdly, as an investigator. A few salient features of these phases of work may be noted.

For the head of a museum of natural history, Professor Hyatt had many and marked qualifications; his knowledge of zoology, of paleozoology and of geology was extensive; he was skilful in manipulation, suggestive in council, enthusiastic and approachable.

His plan that a natural history museum should be arranged so that a visitor on entering should pass from the simpler groups to those more specialized, and that the specimens in each case should be similarly classified, though opposed as impractical, is both sound and feasible. Somewhat disposed in late years to a too great use of diagrams and models in place of actual material, his recognition of the value of these, of descriptive labels and of a personal guide was early, important, and helpful. His invention of the 'Hyatt bracket' gave an accessory at once simple, effective, and inexpensive, and applicable for greater use than that for which it was planned. It is true that the full realization of much of his best museum work and thought is left for appreciative successors, as Professor Hyatt was too apt to be content with an initiative, the result of which he clearly apprehended, and did not always give attention to the actual carrying out of details, details that in many cases required continuous interest through successive years.

Professor Hyatt's reputation as a teacher will rest largely on the work he did for the Teachers' School of Science. His management of this school was very skilful, and his lectures, of which he gave many courses, were uniformly successful. It was here that he enforced the value of direct observation and comparison, and transmitted the spirit instilled into him by Agassiz to another generation of teachers, many of whom to-day attribute a large share of their success to his methods. His direct influence upon the work of other lecturers in this school may also be mentioned. His early maintenance of a seaside laboratory at Annisquam, Mass., the resources of which were open to teachers so far as space and means would allow, was also an important educational mode.

In the pursuit of his investigations, Professor Hyatt not only studied the accumulations preserved in museums in this country and abroad, but he partook in active field work; he dredged off the east coast at various points from Labrador to Noank, Conn., and explored many geological horizons in Canada, the Maritime provinces, New England, New York and the far west. His published writings, though less numerous than those of some of his contemporaries, are many and important; they cover a wide field in the Invertebrata, both fossil and recent, and in some cases represent pioneer work in the group studied.

The titles of a few of the more important of his publications may be noted: Observations on Polyzoa (1866–68); On the parallelism between the different stages of life in the individual and those of the entire group of the molluscous order Tetrabranchiata (1867); Fossil cephalopods of the Museum of Comparative Zoology. Embryology (1867); Revision of the North American Porifera (1875–77); The genesis of the Tertiary species of *Planorbis* at Steinheim (1880); Genera of fossil cephalopods (1883–84); Larval theory of the origin of cellular tissue (1884–85); Genesis of the Arietidæ (1889); Bioplastology and the related branches of biologic research (1893); Phylogeny of an acquired characteristic (1894); Cephalopoda (1900).

From the beginning Professor Hyatt's researches were very largely devoted to evolutionary questions, and to the special study of fossil cephalopods; at the time of his death he was one of the foremost authorities upon the fossil Cephalopoda. The true value of his work upon this group must be left for the future; memoirs such as the Genera of fossil cephalopods (1883–84), and the chapter on the Cephalopoda (1900) contributed to the English issue of Zittel's 'Palæontology' cannot be properly estimated by the present generation; they require prolonged and detailed study founded upon large series of specimens. His theory of parallelism based on acceleration and retardation, and his discoveries concerning the laws of development, growth and decline were advocated with persistence and vigor; and while his treatment is not always lucid, he is to be credited as the originator of a distinct school, a school devoted to exact methods of research. The growth of this so-called Hyatt school, never of greater importance than at the time of his death, was a source of sincere gratification to him.

Samuel Henshaw.

SCIENTIFIC BOOKS.

Dictionary of Philosophy and Psychology. Written by many hands and edited by James Mark Baldwin, Ph.D., with the coöperation and assistance of an international board of consulting editors. In three volumes, with illustrations and extensive bibliographies. Vol. I. New York, The Macmillan Company. 1901.

In considering an enterprise of such magnitude as this dictionary offered by Professor Baldwin, the reviewer should keep in mind several important points. He should remember the purpose which guided the editor in his work, its value to those for whom it is especially intended, and the great difficulties of the undertaking. He should not measure it by ideals which the editor never aimed to realize and which it was not necessary for him to realize under the circumstances. Two purposes are combined in the work, Professor Baldwin tells us—'first, that of doing something for the thinking of the time in the way of definition, statement and terminology; and second, that of serving the cause of education in the subjects treated.' The task, therefore, is 'to understand the meanings which our terms have, and to render them by clear definitions; and to interpret the movements of thought through which the meanings thus determined have arisen, with a view to discovering what is really vital in the development of thought and term in one.' The other part of the problem is pedagogical and carries with it the duty 'to state formulated and well-defined results rather than to present discussions.' The reader, therefore, who expects to find nothing but original articles written for experts and by experts, a work, for example, like Schönberg's 'Handbuch der politischen Oekonomie' or Conrad's 'Handwörterbuch der Staatswissenschaften,' will be disappointed. There are, indeed, 'special' articles on certain topics, and these are of 'encyclopedic character,' but they are in the minority. The Dictionary is meant primarily for the student, not for 'the practised man of research'—a fact which should be kept constantly in view. This will also help to explain the great scope of the enterprise, as set forth in the subtitle: 'including many of the principal conceptions of ethics, logic, æsthetics, philosophy of religion, mental pathology, anthropology, biology, neurology, physiology, economics, political and social philosophy, philology, physical science and education.' The editor justifies himself for attempting to cover such an enormous field with the statement that 'the introduction to a large subject—philosophy, indeed, is the largest subject—must needs include various details of knowledge of other branches of science and information, and of methods, preliminary to its proper task.' The wide inclusion of science receives further justification from the editor's conception of philosophy and of its relation to science. Philosophy is for him 'the attempt to reach statements, in whatever form, about mind and nature, about the universe of things, most widely conceived, which serve to supplement and unify the results of science and criticism.' "It is," he says, "one of the safest sayings of philosophy, at the close of the outgoing century, that whatever we may become to end with, we must be naturalists to begin with—men furnished with the breastplate of natural knowledge. We must know the methods as well as the results of science; we must know the limitations of experiment, the theory of probability, the scientific modes of weighing evidence and treating cases. Lack of these things is the weakness of many a contemporary writer on philosophy. Such a one criticises a science which he does not understand, and fails to see the significance of the inroads science is making into the territory which has so long seemed to be exempt. Note the application of biological principles, in however modified form, to psychological facts; the treatment of moral phenomena by statistical methods; and the gradual retreat of the notion of purpose before the naturalist, with the revised conception of teleology which this makes necessary." The prominent place given to psychology is another necessary consequence of the editor's standpoint, and will receive the approval of all who agree with him as to the fundamental importance of this discipline for science on the one hand, and philosophy on the other. "In biology, in sociology, in anthropology, in ethics, in economics, in law, even in physics," he declares, "the demand is for sound psychology; and the criticism that is making itself felt is psychological criticism. How could it be otherwise when once it is recognized that science is the work of mind, and that the explaining principles by which any science advances beyond the mere cataloguing of facts are abstract conceptions made by processes of thought?" All this is very good, and most modern thinkers will have no difficulty in accepting it. The philosopher cannot ignore science, nor can either he or the scientist do without psychology.

Taking the Dictionary, or rather the first volume of it, as a whole, and judging it by what it sets out to do, we cannot withhold from it our full measure of praise. It is beyond question the best production of its kind in the field, and will doubtless prove a valuable aid to those for whom it was made; indeed, there are few, if any, interested in the general philosophical branches who will not find it a useful vade mecum. Professor Baldwin and his collaborators certainly deserve the gratitude of all students and teachers of philosophy and psychology in the English-speaking world for the arduous task which they have so successfully performed.

And now a word or two with respect to particular points. One of the objects of the Dictionary is to do something in the way of definition and terminology. This is, of course, a highly commendable aim. But there seems to us to be some danger of *over*doing the thing, of attempting to define what cannot be defined, or at any rate cannot be defined satisfactorily within the narrow limits of a sentence or two. Some of the older American philosophical text-books were in the habit of defining or at least trying to define concepts like consciousness, mind, feeling, etc., and many persons who have used these books still remember the thought-destroying effect produced by their study. Perhaps these experiences have made us too sceptical with regard to certain definitions, but it does not seem that we are helped very much by statements like the following: "Activity (mental). If and in so far as the intrinsic nature of conscious process involves tendency towards a Terminus (q. v.), it is active process, and is said to have activity." "Admiration. Feeling as going out in active approval." "Attention. The mind at work or beginning to work upon its object." "Being. The most general predicate possible and to be affirmed of anything whatever." "Consciousness. The distinctive character of whatever may be called mental life. It is the point of division between mind and not mind." "Determination. The cooperation of all the factors which adequately condition and issue in a mental End-state (q. v.)." "Feeling. Consciousness as experiencing modifications abstracted from (1) the determination of objects, and (2) the determination of action." Perhaps the best thing we can do in many cases is to confess our inability to give satisfactory definitions, as the German professor did, who, when told by one of his students in an examination that he did not know what an animal was, frankly declared that neither did he. So far as the terminology is concerned it is to be hoped that the Dictionary will bring about some uniformity of usage. Its recommendations are, as a rule, very sensible, and there is no reason why they should not be adopted.

With respect to the value of the different articles there will, of course, be difference of opinion. Most of them, however, serve their purpose well. Among those pertaining to philosophy and closely allied subjects the following do not seem to receive the treatment which their importance demands: Analogies of Experience; Association of Ideas; Conscience; Cause Theory (perhaps the article on Parallelism will supply the deficiency); Deism; Dialectic; Dogmatism (Kant's meaning of the term is not clearly brought out); Education; Empirio-criticism; Free Will (and determinism); Innate Ideas (Leibniz's view should be mentioned here); Instruction. The following are among the most helpful and suggestive: Cause; Cause and Effect; Change; Epistemology; Experience; Greek Terminology; Hegel's Terminology; Kant's Terminology (unfortunately this does not include Kant's ethical and æsthetic terminology); Judgment; Latin and Scholastic Terminology. The articles on psychology and æsthetics are generally very good.

The number of subjects discussed in the first volume is quite large, and the Dictionary seems to be very complete in this respect. It would, of course, be impossible to give each possible topic a separate place in the book; many things will have to be considered together under general heads, and the index to the entire work, which is to appear at the end of the second volume, will most likely help the student in his search for certain terms. Perhaps some of the following subjects, which I have tried to find, may turn up in this way: Animal Spirits; Astrology; Corpuscular Theory; Duty (and inclination); Dynamism; Dysteleology (a term coined by Hæckel); Eduction (a term used by some English logicians); Egoism (in the sense of solipsism); Energetik (the term used by Ostwald); Ethelism; Ethical Culture Movement; Euhemerism; Evaluation; Idiopathic (as contrasted with sympathetic, a term frequently used by the Germans—*e. g.*, by Paulsen); Illusionism; Individualism (ethical. Reference might here be made to the article on Anarchism); Intelligible and Empirical Character. There are two articles which might easily be brought under the same head: Ætiology and Etiology. In the article on Determinism we are referred to an article on Free Will Controversies. There is no such article. There ought to be a reference under Empirio-criticism to the article on Introjection, which gives one a much better idea of Avenarius's system than the first article.

The biographical part of the work is, in my opinion, capable of great improvement. Many important names are left out, many unimportant ones given. Every one cannot be mentioned, of course, but it would be a distinct gain if names like Alanus ab Insulis, Antisthenes, Aristarchus of Samos (he is, it is true, mentioned under the Copernican Theory), Beda Venerabilis, Bolingbroke, Buridan, Calderwood, Cardanus, Digby, Euler, Fiske, Galileo, Gaunilo, Gerbert, Gizycki, Glogau, Guyau, Hamann, Hegesias, Herschel, Wilhelm von Humboldt, Kepler, Laas, Lamennais, Lanfranc, Laplace, to call attention to but a few prominent omissions, could take the place of: Abbadie, Abdalatif, Achenwall, Johann Alanus, some of the Alexanders, Allamand, Arnott, Atwater, Beaseley, the two Hodges and others comparatively unimportant. It is a pity, too, that no biographies are given of living thinkers, say of men like Baumann, Brentano, Dühring, Eucken, Kuno Fischer, Fouillée, Hartmann, Höffding, Jodl, to say nothing of English and American writers of note; but perhaps that would have increased the size of the work beyond all reasonable expectations.

The bibliographies are unequal in value. The psychological bibliographies are usually excellent, including, as they do, the best monographs in the field. The literature on æsthetics is also good. The philosophical, logical, ethical, epistemological and educational lists of references, cannot as a rule compare with the others; some of them are quite meager, often ignoring the best recent literature. It is one of the most valuable functions of a work like the Dictionary to guide the student in his reading and to put him in touch with the best work done everywhere. It would be an advantage if the third volume of the Dictionary could give not only the *names* of books, but critical comments on some of them.

In conclusion I should like to call attention to a few minor details. There should be some uniformity (1) in German spelling, (2) in the use of the English possessive, and (3) in French titles. Sometimes the old style of German spelling is used, sometimes the new. We get *Urteil* and *Urtheil, Funktion* and *Function, Defekt* and *Defect, Produkt* and *Product,* etc., etc. Sometimes the Dictionary uses the apostrophe followed by *s* in English possessives ending in *s,* sometimes it uses the apostrophe only. Thus we find St. Vitus's, Cornelius's, James's, St. Thomas's, Leibnitz's, and Descartes', Averroës', Leibnitz', and so on. In the French titles capitals are sometimes used and sometimes not. There are a few other cases in which we get differences in spelling. The Dictionary writes Kratylus and Kritias, but Crates, Carneades, Cleanthes. Quesnai and Quesnay occur, Frankfurt and Frankfort, Clement and Clemens, Renaissance and Renascence, spatial and spacial, and if I am not mistaken Occam and Okham.

The terms adoptionism and *Adoptionismus* are used instead of adoptianism and *Adoptianismus,* which are the more common forms. Clanberg should be Clauberg. Instead of *Agent* the Germans use the term *Agens* in the sense employed on page 25. The usual German equivalent for common sense in the meaning given on page 200 is *gesunder* or *gemeiner Menschenverstand. Askese* is more common than *Asceticismus.* The counter-reformation is *Gegen-reformation* in German. On page 92 Höffding is referred to as an authority on mediæval philosophy. Schmidt's 'Ethik der alten Griechen' is spoken of as a history of ethics on page 344; it is a history of Greek morality and ideals rather than of Greek systems. The title of Ziegler's book is: 'Die Ethik der Griechen und Römer.' On page 67 the term patristic fathers is used. On page 500 a passage from Munro's translation of Lucretius is given without credit. On page 5 a translator's name is given as Filkin, on page 189 as Falkin, on page 557 as Felkin. Homoousios (p. 67) should be homoi-ousios. On page 596, first column, eighth line from the bottom, the word *to* should be placed between *that* and *phenomena.*

Typographical errors are: *Nature* for *Natur* (p. 5); 1794 for 794 (18); peritheral for peripheral (28); Gaston for Galton (46); base for bare (61); Bohme for Böhme (124); idiomotor for ideo-motor (217); Adeckes for Adickes (246); Elsenhaus for Elsenhans (216); Seipsis for Scepsis (320); *Raumvorstellungen* for *Raumvorstellung* (364); 21 for 214 (521); Frauenstadt for Frauenstädt (537); instinct for institut (579); Mansell for Mansel (347); Micklejohn for Meiklejohn (285); Laud for Land (21); and a few others even more insignificant than the above.

Volume II. will contain the remainder of the text, from Le to Z, Addenda, full indices of Greek, Latin, German, French, and Italian terms, while volume III. will be devoted exclusively to the general bibliographies.

The Macmillan Company deserve great credit for making such a publication possible and for the manner in which they have performed their part of the work. Frank Thilly.

University of Missouri.

Report on a Botanical Survey of the Dismal Swamp Region. By Thomas H. Kearney. Contributions from the U. S. National Herbarium, VI.: 6. Washington, 1901. 8vo. Pp. 263, 12 plates, 39 figures and 2 maps.

The account of the Dismal Swamp vegetation here presented is both a valuable and a thoroughly readable one. The subject is handled from a number of viewpoints in such a way that the reader obtains a well-rounded conception of this particular vegetative covering and of the interrelations of its constituents. The author is especially to be commended for his careful inquiry into the causes which produce the characteristic modifications of the various vegetation forms, and for the histological investigation of certain species, a study which is altogether too rare as yet in ecological research.

Under 'Climate' the author discusses the usual physical factors, temperature, sunshine, humidity, precipitation and wind, though the data unfortunately could not be secured for the Swamp itself, but only for the neighboring meteorological stations, Norfolk and Cape Henry. The prominent physiographic features of the region, to which correspond, of course, certain plant formations, are (1) the beach and the dunes, (2) the salt marsh, (3) the plain and (4) the swamps. A very important discussion of the soils of these areas is contributed to this portion by Mr. F. D. Gardner, of the Division of Soils.

In the treatment of the vegetative covering of the region, the author recognizes a maritime and an inland group of formations. The former comprises the saltmarsh formation and the sand-strand formations. Under the first are arranged a number of associations, *Spartina stricta* association, *Typha* association, *Juncus* association, which are, in fact, alternating areas of the formation, in which a certain facies or principal species is controlling. Little attention is given to the relative importance of the species constituting the formation, or to their sequence in time. The most important physical conditions which cause modification in saltmarsh plants are partial submersion at high tide, a soft yielding substratum and an excess of sodium chloride in soil and water. The resulting modifications are largely concerned with the reduction of the water loss, as is typical of halophytes, by thickening the cuticle and the epidermal walls, by the development of a dense hairy covering, the sinking of the stomata, the conduplication of the leaf, or its partial or complete reduction, the development of succulency, the presence of a considerable quantity of salts in the cell sap, and the development of palisade tissue. The value of the sheathing bases of the old leaves in preventing the access of salt water must be regarded as somewhat doubtful. The consideration of the sand-strand vegetation is clear and interesting. The beach and outer dunes are characterized chiefly by *Ammophila arenaria, Uniola paniculata, Iva imbricata, Panicum amarum minus, Cakile edentula* and *Salsola kali.* The vegetation of the middle dunes is much less open in nature. The most characteristic feature is, perhaps, the dense, often pure, thickets of *Myrica carolinensis.* Other thickets are constituted by *Prunus angustifolia, P. serotina, Salix fluviatilis* and *Cephalanthus occidentalis.* The inner dunes are wooded for the most part with *Pinus tæda,* but a number of deciduous trees and shrubs, *Quercus, Diospyrus, Sassafras* and *Juniperus,* occur here also. An excellent analysis of the effect of the mechanical action of the wind, and of the effect of excessive transpiration follows the floristic discussion.

The non-hygrophile inland formations are (1) forest formations, embracing the mixed forest and the pine barrens, (2) cleared-land formations, non-cultural and cultural, (3) fresh-water formations, comprising the hygrophile forest, with its two types, the black gum swamp and the juniper swamp, and the fresh-water marsh formation, with the reed marsh and the low-marsh types. The phytogeographical affinities of the flora are discussed at some length, touching upon the position of the species in the various vegetation zones. The northern limit of Dismal Swamp species is tabulated in an exhaustive manner. The broader relationship of the flora receives some attention also, a number of interesting comparisons being made. The agricultural products of the region are touched upon briefly, special consideration being given to the influence of drainage and soil composition upon the native and cultural vegetation.

Anatomical notes upon the leaf structure of a number of the most interesting species ecologically constitute a very important feature of the work. The notes treat chiefly of the adapted structures of the leaf, embracing a brief description of the leaf, the epidermis, mesophyll, mestome and stereome. Much is to be said in commendation of thorough histological work of this sort, a field of investigation which must come to play an increasingly important part in all comprehensive ecological work. The text closes with a list of the plants of the region, a bibliography of the books and papers consulted, and a full index.

FREDERIC E. CLEMENTS.

UNIVERSITY OF NEBRASKA.

Monographie der Termiten Afrikas. By Yngve Sjöstedt. Köngl. Svenska Vetenskaps-Akademiens Handlingar, Vol. xxxiv., No. 4, 1900 (received late in 1901). Pp. 236. Plates IX.

Africa, the classic land of Termites, has, in recent years had its termitid fauna quite thoroughly explored. New species have been coming thick and fast from the pens of Sjöstedt, Wasmann, and Haviland; and now the work is capped by an excellent monograph from the hands of the Swedish student.

The author has had at his disposal practically all of the available material, and with great care has produced a work that will always be the basis for the future study of African white ants. Descriptions are given of 82 species, arranged in six genera; and tables are given for the determination of the species. One of the notable features of the work is the attention paid to biology. The habits of each species, when known, are detailed at considerable length, and four of the plates represent nests or parts of them. We are accustomed to think of Termite nests as being pyramidal in shape, but this applies only to certain species of *Termes;* the nests of *Eutermes aurivilli* and *E. fungifaber,* which are illustrated, are larger at the top than at the base, and have the appearance of some gigantic mushroom. The tree-nests of *E. arborum* and *E. arboricola* are also figured, the former attached to the twigs, the latter to the trunk of a tree. Accounts are given of how the natives collect certain species for eating, and of how other species collect grass and leaves, and conduct their mushroom gardens. Two bibliographies are appended: One, a list of papers on African termites; the other, a list of termitid literature published since Hagen's 'Monograph of the Termites' in 1855.

NATHAN BANKS.

SCIENTIFIC JOURNALS AND ARTICLES.

THE January number of the *Botanical Gazette* (the first of Volume XXXIII.) opens with an article on 'Binucleate Cells in Certain Hymenomycetes,' by R. A. Harper, of the University of Wisconsin. Dr. Harper confirms and extends the results of Maire, finding the young cells of numerous Hymenomycetes to be binucleate. On the basis of these and other observations he then discusses the relationship of the Basidiomycetes with the Ascomycetes, controverting the conclusions of Massee, and holding that "the widespread occurrence of regularly binucleated cells in the Basidiomycetes, with the additional evidence that these cells reproduce by conjugate division and constitute the reproductive series in each individual through at least a considerable part of its life-history, leading up to the formation of basidia, while no such binucleated cells are found in Ascomycetes, in either vegetative or ascogenous hyphæ, shows that the two groups are widely separated phylogenetically. * * *

On the other hand, it is quite clear that the binucleated condition in the hyphæ of both groups still further strengthens the evidence for the relationship between the rusts and Basidiomycetes."

Judson F. Clark, of Cornell University, discusses the 'Toxic properties of some copper compounds, with special reference to Bordeaux mixture.' Clark shows that solution of such of the Cu $(OH)_2$ in Bordeaux mixture as is of fungicidal value, is chiefly accomplished by the solvent action of the fungus spores themselves, the total amount of copper necessary being probably not more than one part in 80,000. The amount of injury done to the host, which also has the power of absorbing the copper hydroxid deposited on its leaves, depends on the specific susceptibility of the protoplasm, the solvent properties of the cell sap, the permeability of the epidermis, and the weather conditions following spraying.

G. P. Clinton, of the University of Illinois, announces the discovery of *Cladochytrium Alismatis* Büsg. on *Alisma Plantago,* near Cambridge, Massachusetts. This is the first time this fungus has been found in America. He describes also a peculiar temporary sporangial stage which it had not been previously known to possess. He was also successful in germinating the resting sporangia, which had not been accomplished before.

J. C. Arthur, of Purdue University, discusses briefly 'Clues to Relationships among heterœcious Plant Rusts,' and Leslie N. Goodding describes six new species of plants from the Rocky mountain region.

Fifteen pages of reviews of current literature and four pages of news complete the number.

The December number of the *American Geologist* contains a portrait and a short biographical sketch of the late Ralph D. Lacoe of Pittsburg, Pa., by the Rev. H. F. Hayden. Also the scientific work of the late W. H. Barris of Davenport, Iowa, is described briefly by C. H. Preston and the article accompanied by a portrait. Neither of these men were professional scientists but their contributions to paleontology are valuable and lasting. 'The Loess of Iowa City and Vicinity' is discussed by B. Shimek. He describes the fossils found in the loess and compares them with the forms now living in the vicinity and other loess deposits. E. R. Cummings discusses 'A Section of the Upper Ordivician at Vevay, Indiana,' accompanying the article with two plates of fossils. 'The Cleveland Water Supply Tunnel,' by S. J. Pierce. From the evidence furnished by this tunnel and other work done in the vicinity the author describes a deep V-shaped preglacial valley emptying into Lake Erie, about nine miles long and at its greatest depth 450 feet below the lake level.

The Journal of Physical Chemistry. November. 'Equilibrium between Carbonates and Bicarbonates in Aqueous Solution,' by Frank J. Cameron and Lyman J. Briggs; 'Solubility of Gypsum in Aqueous Solutions by Sodium Chlorid,' by Frank K. Cameron. These papers are communications from the Bureau of Soils of the United States Department of Agriculture. 'Mathematical Expression of the Periodic Law,' by S. H. Harris; 'The Optical Rotatory Power of Cane Sugar when Dissolved in Pyridin,' by Guy Maurice Wilcox.

December. 'Oxidation of Ferrous Solutions by Free Oxygen,' by J. W. McBain. It is found that the oxidation of ferrous solutions by free oxygen is unexpectedly slow and that it increases with the concentration of the ferrous salt. 'Some Applications to Chemistry of J. J. Thomson's Work on the Structure of the Atom,' by Felix Lengfeld; 'Solubility of Gypsum in Aqueous Solutions of Certain Electrolytes,' by Frank K. Cameron and Atherton Seidell. A further study from the Bureau of Soils. In dilute solutions the solubility curves follow the direction indicated by the application of the mass law to the hypothesis of electrolytic dissociation. For high concentrations this is not generally the case, but in such solutions ionic complexes seem to be formed.

SOCIETIES AND ACADEMIES.

THE NORTHEASTERN SECTION OF THE AMERICAN CHEMICAL SOCIETY.

The regular monthly meeting of the Section was held in the rooms of the German Turnverein on Tuesday evening, January 28. Dr. James Locke, of Yale University, addressed the Society on 'Some Recent Problems in the Systematization of Inorganic Compounds.' The paper was a résumé of some work on the solubility of various alums, and of certain double sulphates, which has been in progress for several years in the laboratories of the Sheffield Scientific School. It was shown that when the solubility of the alums of aluminium, vanadium, chromium, and iron with ammonium, sodium, potassium, cæsium, rubidium, and thallium is expressed in gram-molecules per liter of water as a function of the atomic weight of the trivalent metal, a figure is obtained in which the straight lines connecting the solubility of any two trivalent metals with successive univalent metals meet in a point, if prolonged. It was assumed that the points of solubility stand in fixed mathematical ratio to one another, and it was shown that if the difference of the solubility of the alums of a trivalent metal with two alkali metals is called the increment of solubility of the latter, then the ratio between the increments of solubility of the corresponding alums of two trivalent metals for any two alkali metals is a constant. This general law was amply confirmed by the experimental results, and it was shown that the solubility of new alums could be predicted with considerable accuracy.

Dr. B. S. Merigold, of the Worcester Polytechnic Institute, read a paper on 'Some Recent Work on Uranium,' in which he described the method and apparatus for obtaining pure anhydrous uranous bromide and the use of this substance for the determination of the atomic weight of uranium. The mean value of two sets of experiments was 238.52, about one unit lower than the recent values of Zimmerman.

HENRY FAY,
Secretary.

SECTION OF ANTHROPOLOGY AND PSYCHOLOGY OF THE NEW YORK ACADEMY OF SCIENCES.

A MEETING was held on January 27. The chairman, Professor Farrand, after opening the meeting, called on General James Grant Wilson to preside.

Mr. F. S. Dellenbaugh explained his understanding of the location of the historic towns and 'nations' of the Rio Grande valley in New Mexico prior to 1630. This differs radically and entirely from the present accepted arrangement. He maintains that the location of Tiguex, rather than Cibola, is the key to the correct solution of this problem, and from strong evidence derived from Benavides, Espejo, Castañeda and others, he locates Tiguex near San Antonio station. The site at Bernalillo, for this central town, so long advocated by Bandelier and his followers, he declares is impossible. With Tiguex at San Antonio station, the famous 'Seven Cities of Cibola,' which Bandelier placed on the site of modern Zuñi, are thrown instead into southwestern New Mexico, either on the Gila near Old Camp Vincent, or Old Fort West, or between these and the Florida Mountains, with the balance in favor of a site on the Gila. Cicuyé, instead of being at Pecos, was apparently a Tompiras town, either what has been erroneously called *Gran Quivira* or some village of that locality. The Braba of Coronado would fall in the vicinity of the present Cochiti, instead of at Taos, and Tusayan instead of being at the Moki Towns, would fall in its position 20 leagues (50 or 60 miles) northwest of the position of Cibola.

Mr. Harlan I. Smith presented a paper on the 'Hauptman Earthwork,' in Ogemaw County, Michigan. The discovery of this earthwork was first announced by him in SCIENCE, June 21, 1901 (p. 991). Personal observation in July enabled him to correct its location somewhat. It is on Section 33 or 34, or both, T. 22, N. (instead of 21), R. 1, E. It was found to lie in a lumbered pine area, and, unlike most such earthworks, far from any watercourse. It is covered by dense undergrowth and fallen timber. It is composed of a rounded embankment of earth, about 2 feet high and 12 feet wide, encircling an area about 197 by 177 feet; outside this is a ditch, 2 feet deep, 6 feet wide at the top, but narrowing towards the bottom. Signs of another embankment were seen outside the ditch, and within the enclosed area were several humhocks which may prove to be mounds or similar works. There are three openings in the embankment. The antiquity of the work is indicated by the presence of large pine stumps on the embankment and in the ditch; the largest stump measured 13 feet 4 inches in circumference.

An effort is being made to have this ancient work enclosed in a state, county or township park. The land, now worth perhaps less than $10 an acre, can easily be secured. If neglected, the road to be built on the line between sections 33 and 34 will probably destroy the work.

Dr. John R. Swanton reported some results of his investigations into the mythology and origin of the Haida Indians of northern British Columbia. The whole Haida people is divided into two clans, Raven and Eagle, each of which is strictly exogamic with descent in the female line, and has its own crests, its own names, its independent traditional centers of origin. Each is subdivided into a number of families. The Raven clan traces its origin from a single legendary ancestress, who is reputed to have emerged from the waters with the Haida island. Some families of that clan, however, trace their descent from other sources. The Eagle clan has much less traditional unity of origin, and there are certain indications in the tradition that this clan is of foreign origin or at least has received considerable admixture of foreign blood. One important fact that seems to point to the Raven clan as the indigenous element is the great preponderance of Ravens among the supernatural beings of the island.

R. S. Woodworth,
Secretary.

SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY.

The Section of Astronomy, Physics and Chemistry met at the Chemists' Club on February 3. Mr. G. B. Pegram addressed the Section on the subject of 'Experimental Methods of Studying Radio-Activity.' Mr. Pegram described the principal methods which have been used in the study of radio-active substances and also gave a brief summary of the more important results so far obtained. The address was followed by a very interesting discussion of the subject.

F. L. Tufts,
Secretary.

ZOOLOGICAL CLUB, UNIVERSITY OF CHICAGO.

At the meeting of October 23, 1901, the following paper was presented:

'The Origin and Development of the Wings of Coleoptera': W. L. Tower.

The embryonic origin of the wings was studied in *Lepitinotarsa decemlineata,* where the hind wings were found to be derived from the rudiment of the metathoracic spiracle. The elytra are also probably derived from the remains of the mesothoracic spiracular disk, which are left in the segment after the anterior migration of the spiracle of the mesothorax.

In the larvæ of several species of beetles the wings were found to develop in one of three ways: (1) Directly beneath the cuticula—Carabidæ, Cerambycidæ, Buprestidæ and others; (2) in a shallow peripodal sac, which is broadly open against the cuticula—Scarabæidæ; (3) in a closed peripodal sac which is removed to a greater or less distance from the surface—Coccinellidæ, Chrysomelidæ.

In the wings there is a larval temporary tracheal system which develops from the cells of the hypotrichal membrane of the tracheal trunks. This system is functional in the late larva, prepupa and early pupa, but is destroyed during the pupal stage, probably by ferments in the hæmolymph and not by phagocytes.

The elytra and hind wings were found to have an essentially similar structure, both gross and microscopic, and are therefore homodynamous organs. The development of scales and glands, the development and finer structure of the cuticula, and the behavior of the hypoderm were followed in detail, and have given interesting results.

The conclusion reached is that the wings of beetles are homologous to those of other insects, but are specialized by reduction. They are not divergent organs specialized for a new function, as was stated by Krüger.

MEETING OF NOVEMBER 6, 1901.

'Spermatid Transformations in *Gryllus*

assimilis with Special Reference to the Nebenkern: W. J. Baumgartner.

After the anaphase of the second spermatocyte division, the chromosomes separate and break up as has been described in other forms. But as the nucleus elongates to form the head of the spermatozoon, it forms a tube instead of a solid mass as described for other forms. The head has a darkly-staining outer wall of chromatin, and a hollow clear space probably filled with nuclear sap.

The remaining fibers, after they are cut by the division-plane, become fewer and thicker; their ends bend together and they form a 'striated' nebenkern, a condition not previously described. This striated nebenkern looks like an egg with dark drawn-out ends, and several (frequently five) dark cross striæ parallel with the long axis of the cell.

In a relatively short time the fibers break up, and soon the dark-staining substance appears as a round ball, which, with the immediately surrounding clear space, is enclosed by a surrounding membrane. In cross-section this appears as a dark circle, a ring of clear space and another dark ring.

As the axial filament grows out it passes over the surface of the bounding membrane, and not through the nebenkern. Soon after this the nebenkern elongates, loses the ring, and the dark ball passes back (away from the nucleus) along the tail, sometimes breaking up into several small drops. The substance is thus distributed over the tail and forms a covering for it.

A second body in the cytoplasm is smaller and always lies in the angle between the nucleus and the nebenkern. As the nebenkern passes backward and disappears, it moves up against the nuclear membrane, passes to the front end of the elongating head and forms the point. Its origin could not be determined, but from its destiny it corresponds to an acrosome.

C. M. Child,
Secretary.

THE TEXAS ACADEMY OF SCIENCE.

The formal midwinter meeting of the Texas Academy of Science was held in the rooms of the Business Men's Club, at Waco, on Thursday evening, December 26, and Friday morning, December 27, 1901.

The speaker at the evening session was Dr. Frederic W. Simonds, Professor of Geology in the State University. He was introduced by the president, Professor J. C. Nagle, of the Agricultural and Mechanical College of Texas.

The subject as announced was 'Petroleum.' The speaker opened with a brief statement concerning the oil development in the State of Texas—a comparison having been made with the fields in the North and in California. He then entered upon a discussion of the nature of petroleum, showing its position in the hydro-carbon compounds and commented at some length upon its physical properties. The theories of the origin of petroleum received special attention, references having been made to the early work of the late Dr. T. Sterry Hunt and the more recent work of the late Professor Orton as well as to the investigations of many other distinguished students. The evolution of the oil well from that which was hand drilled to the modern steam drilled well was discussed and the latest statistics of the oil industry both in the United States and in Texas announced. With the generous assistance of Dr. A. F. Sontagg thirty excellent illustrations of the present condition of the oil development in Texas, including several Beaumont gushers, were thrown upon the screen.

At the morning session the following papers were presented: 'The Petroleum of Jefferson County, Texas,' by Professor H. H. Harrington, of the Agricultural and Mechanical College of Texas. Of this oil he says: "It makes an excellent fuel oil; but this is not to my mind its most promising feature. The sulphur which it contains (about 2 per cent.) is larger than that found in any other known petroleum; and is a menace to it as a source of illuminating oil or kerosene. Unlike most other oils in the United States, it has asphalt for a base * * *. This, it seems to me, is the key to its usefulness. Distilled it furnishes a good quantity of kerosene fraction, but with a high boiling-point and leaves a residue of fine asphalt, not excelled perhaps by that of

Trinidad. A protective tariff on asphalt is all that is needed to increase the value of the Beamont residue.

* * * * *

The following is a detailed analysis of the oil: Sp. Gr. = .912—very heavy. Begins to distill at 70°C. and boil at 150°C.:

70°—150°C.— 3.337 %	comes	over.	
150°—260°C.—41.00	"	"	"
260°—300°C.—19.00	"	"	"
300°—350°C.—20.00	"	"	"
Above 350°C.—16.67	"	"	"

"The first distillate below 150°C. is what is ordinarily known as the 'Benzine Fraction,' and as noted is 3.33% of the crude oil; it boils at 70°C. 150° to 260°C. is the illuminating oil fraction; 260° to 300°C. are the light lubricating oils; and 300° to 350°C., heavy lubricating oils, mixed with asphalt. The remaining 16½% is asphalt. As before mentioned, the amount of sulphur in the oil is the greatest obstacle in the way of refining it. When the illuminating fraction is refined, it requires the use of a much larger percentage of sulphuric acid, and the loss on refining from treatment with this acid is much greater * * than takes place with oils having a paraffine base and very little sulphur."

Professor Frederick W. Malley, of the Agricultural and Mechanical College, presented a paper on 'Factors of Progress in Insect Warfare,' in which he indicated the lines of effort and research among economic entomologists at the present time and made a comparison with similar work attempted twenty years ago. He grouped the warfare roughly into four great divisions: Insecticides, Cultural Methods, Parasites and Natural Enemies, and Climatic Conditions. The whole discussion was from the standpoint of *applied* entomology and a plea was made for elementary instruction along these lines in the public schools of the State.

Professor D. W. Spence, of the Agricultural and Mechanical College, discussed the 'Effects of Prolonged Exposure to X-rays on the Human Body,' showing their extraordinary effects, in some instances, in producing a disintegration and diseased condition of the skin. He himself had his hand in bandages covering a 'burn' of some months duration and not yet healed.

'A Preliminary Report on the Austin Chalk Underlying Waco and the Adjacent Territory' is the title of a paper presented by Mr. J. K. Prather. The rocks of this formation within the area mentioned were described minutely and their position in the great Upper Cretaceous Series, pointed out. Reference was made to the early work of Dr. Ferdinand v. Roemer and a list of fifteen characteristic fossils given. Examples were also given of the vertebrate remains found in this formation and attention called to the fruitfulness of this field for investigation in that direction.

Professor T. U. Taylor, of the Engineering Department of the University of Texas, gave an account of the 'Big Springs of the Edwards Plateau'—the region bounded by the Colorado River, the International and Great Northern and the Southern Pacific railroads—showing their fluctuation in discharge and offering an explanation therefor.

Mr. John K. Strecker, Jr., made a 'Preliminary Report on Reptiles and Batrachians of McLennan County.' In this paper are recorded many interesting and valuable observations extending over a period of years concerning the life and habits of these little-known species of animals.

The closing paper, on 'Dr. Ferdinand von Roemer, Father of the Geology of Texas: His Life and Work,' was presented by Dr. F. W. Simonds of the State University. Dr. Roemer was born at Hildesheim, Hanover, in 1818, and died in Breslau in 1891. In 1845 he visited Texas and wrote the first account of the physical geography and geology of the State. His monograph upon the Cretaceous of Texas—'Die Kreidebildungen von Texas'—appeared just fifty years ago.

Frederic W. Simonds,
Secretary.

University of Texas.

THE ELISHA MITCHELL SCIENTIFIC SOCIETY.

The 139th meeting of the Society was held on February 11, at the University of North Carolina. The following papers were read:

'The Pressure of Light': J. E. Latta.

'A Nineteenth Century Geometry': ARCHIBALD HENDERSON.
'The Absolute Properties of Molecules': J. E. MILLS.

CHAS. BASKERVILLE,
Secretary.

DISCUSSION AND CORRESPONDENCE.

A GEOGRAPHICAL SOCIETY OF NORTH AMERICA.

IF a general American Geographical Society, equivalent in rank to the Geological Society of America, could be developed by following Professor Russell's plan (SCIENCE, Jan. 31), there is no question that great good would come from it; but I do not believe that his plan would lead to the desired end. After stating some of its difficulties, I will present an alternative.

Centralization that weakens local activity is of doubtful value. It is perfectly true that the publications of the existing geographical societies are not always of a high order, but they are the best that the local societies can produce; they serve a very useful purpose in providing opportunity for beginners to publish their early efforts; they are the necessary steps toward something better. Furthermore, several of the local journals, being largely concerned with personal narratives of outings and excursions, are of greater interest to their local readers than any general and scientific geographical journal could be. It would more likely kill than kindle geographical interest to replace such local journals by a high-grade scientific central journal. The sufficient reason for this is that the great majority of the local readers are not geographers. This leads to the next difficulty.

No equivalent of the Geological Society of America could be made by uniting the existing geographical societies of the country. Candidates for membership in the Geological Society are carefully scrutinized. They must have had good scientific training and they must have actually accomplished something in the way of geological work, either in the field or in the lecture room, before they are recommended by the Council of the Society for election. The standard of training and accomplishment is not by any means discouragingly high, but it is set at such a level that membership in the Society really means something regarding a member's geological attainments. There is not a single geographical society in the country in which there is any corresponding requirement for membership. Any reputable person who is willing to pay the necessary fee may be elected. The societies are all glad to add his name to the count of members, and his fee to the treasury. In some of the societies it may perhaps be assumed that a considerable number of members feel a certain interest in the general subject of geography, an interest that is passive rather than active; but in nearly all the societies there is a large number of members whose interest is excited chiefly by the meetings, outings and excursions that the societies promote. Even in this respect, only one society, the Mazamas, exacts any performance as a measure of interest, and the performance that it demands—the ascent of a mountain some thousands of feet in height—is no more a test of geographical training and accomplishment than is the test that might be exacted by a yachting or a hunting club. By all means let the meetings, outings, excursions and mountain ascents continue; let the societies that conduct them flourish; let the publication committees secure the best narratives that the members can produce; but do not let us imagine that the members of these societies are all geographers.

Turning now to constructive suggestions: Let the proposed society be satisfied with the northern part of the New World for its field; let its name be the Geographical Society of North America, in order not to imply that America is all north of the Isthmus, and not to infringe upon the name already occupied by the society long established in New York city. Let the various geographical societies of North America be invited to send delegates, one for every five hundred members, to Pittsburgh next summer at the time of the meeting of the American Association; and let these delegates invite fifty or a hundred persons of real geographical attainments to become 'original members' of the new society. Let those who accept this invitation meet at Washington in Convocation Week, 1903, and proceed with the more formal organization of the society. Let them at the beginning imitate the Geological Society of America and other societies of similar grade by requiring that all approved candidates for membership shall be well-trained and productive students of geography, or of some phase of that broad subject. Let the membership fee be set at such a figure that the society may be self-supporting, able to conduct its own publications. Let essays for publication be carefully scrutinized by the council, and let it be recognized that a merely personal narrative of travel no more constitutes a geographical essay because it mentions a harbor or a hill than it constitutes a botanical essay because it mentions a swamp or a forest. Let it be understood that all communications must present an objective account of some element of inorganic environment, or of some organisms in their environment, or an account of the relationship of the two. Let such treatment of the subject be required as shall indicate that the contributor has had sound training in preparation for his work of observation, description, generalization, inference and so on; let the work of apprentices and amateurs be referred to local societies for further development before acceptance in the general society. In a word, let the beginning be marked by careful attention to quality rather than to quantity. Let growth be sound even if slow. Let membership be accessible not to the mere traveller, the lover of outdoor nature or the reader, but only to the investigator, whether he stays at home or roams abroad. Let a standard be set that will demand training and accomplishment on the part of those who reach it, in contrast to the dilettanteism that suffices for membership in all the present geographical societies.

The manifest difficulty in the way of establishing and maintaining such a society is the great diversity of interests among those who should be considered as trained geographers. The subject is a natural unit for schools in its elementary reaches; but the paths of its maturer scholars are divergent. The geodesist, the meteorologist, the hydrographer, the geomorphologist, the ethnologist, the economist, might perhaps repel rather than attract one another, so unlike are their lines of thought and their methods of work. Their association with other sciences might be stronger than with geography; the geodesist with astronomy, the meteorologist with physics, the hydrographer with engineering, the geomorphologist with geology, the ethnologist and the economist with ethnology and economics. But diversity of specialization characterizes all learned societies. In the Geological Society, the paleontologist does not always listen attentively to the glacialist, nor the petrographer to the physiographer, and all these sometimes fail to follow the local stratigrapher. Diversity of interest does not, therefore, prohibit the effective union of experts; and such a union along geographical lines would be well worth trying. I hope that others who may be interested in any aspect of this scheme will send a statement of their opinions either to Science or to Professor Russell direct. If a considerable measure of interest is thus indicated, let us beg Professor Russell to proceed in the direction indicated by the majority of his correspondents and take the necessary steps for a preliminary meeting at Pittsburgh, so that an effective organization may be made at Washington a year hence.

W. M. Davis.

Harvard University,
Feb. 6, 1902.

THE RISE OF ALKALI SALTS TO THE SOIL SURFACE.

The explanation given by Means (Science, of January 3) of the accumulation of soluble salts on the surface of soils by the differential action of capillary and gravitational pores, seems also to offer a correct explanation of the length of time and large amount of water required for an effectual leaching-out of alkali salts by flooding. The fact shown in the investigations of the California Station, that in coarsely sandy lands the maximum of the salts is found not *at*, but at some distance *below*, the surface, offers a correlative corroboration.

But this explanation certainly does not apply to the case referred to by Means, viz., the Fresno region, where the ground water originally stood forty feet below the surface, while now it is at a few feet, and sometimes *at* and above the soil surface. It is historically certain that the rise of the ground water came about there, as at many other points, not from direct over-irrigation, but by the enormous leakage of water from ditches with porous, sandy bottoms and banks. From these I have frequently traced the water slope sideways until the auger reached a depth of ten or more feet; and the gradual rise of the water level in neighboring wells, whose sides remained dry save within reach of the capillary rise of the water, proved plainly that the water was ascending from the original level by hydrostatic adjustment, not by penetration from above; where as a matter of fact irrigation often had not even begun.

The extraordinary accumulation of alkali salts at the surface that has occurred in the Fresno and some other regions of the San Joaquin valley, are clearly due originally to the leaching upward of the entire mass of alkali in the sub-strata. The investigations of the California Station have shown that in the arid region few uplands normally contain less than from 2,000 to 2,500 pounds of soluble salts per acre in four feet depth; and much more has been found in the silty sub-strata of the Salton basin in southern California, even to 22 feet depth. When all the salts thus contained in 40 feet of material are leached to the surface in addition to the accumulation already existing there, the overwhelming invasion we find where these leaky ditches exist cannot surprise us. E. W. HILGARD.

REPRINTS OF SCIENTIFIC PAPERS.

TO THE EDITOR OF SCIENCE: Will you allow me space for a word concerning a point of professional courtesy? It arose in connection with a personal experience. The incident is wholly trivial, namely, the failure of the publishers, or editor, of the *New York Teachers' Monographs* to furnish the reprints promised of an article which appeared in the October number.

It is the custom of writers on technical science to exchange copies of their published monographs. The brochure is sent frequently with an explicit—and always with at least the implied—request for a similar courtesy in return, upon the appearance of anything of the receiver's own in print. The relation thus becomes one of simple duty, which may not be considered or disregarded at will. To each of his correspondents one owes a debt which is discharged only when copies of his own published work have been sent in exchange.

But the matter goes deeper. The contributor to technical scientific periodicals is rarely, if ever, paid for his writings. These publications, in many instances founded and supported by associations of scientific students, are not primarily commercial enterprises, but vehicles of communication among scholars having common interests and aims. They are means by which is made possible the publication of monographic literature, the printing of which, in the majority of cases, would be too heavy a burden for the individual writer. It is part of the meaning of these technical journals' existence that the process of thus communicating scientific thought shall be facilitated as greatly as possible.

This function has been very widely and generously recognized by the publishers of our reputable scientific periodicals in America. It is expressed in the custom of presenting to each substantial contributor a larger or smaller number of separately bound reprints of his article for distribution. Upon the free exchange of monographs which thus becomes possible the scholar depends in no small degree for the equipment of his working library; for this literature, which represents the points of immediate growth in special lines of thought, finds its way only slowly and incompletely into permanent print. It is, therefore, a matter of serious and general importance that these relations between contributor and publisher should be cordially maintained, and the flagrant infraction of them should not remain unknown. ROBERT MACDOUGALL.

NEW YORK UNIVERSITY.

THE SACRAMENTO FORESTS OF NEW MEXICO.

TO THE EDITOR OF SCIENCE: In a communication to your paper dated November 8, 1901, upon the Sacramento forests of New Mexico, the typist made me say that trees 25 feet in diameter were quite common. It was my intention to say 'trees from two to five feet,' etc.

Robert T. Hill.

SHORTER ARTICLES.

NOTE ON THE EMBRYO OF NYMPHÆA.

Although the mature embryo of *Nymphœa* Sm. has been frequently figured and described during the last half century as typically dicotyledonous, the interesting paper of Mr. Lyon on *Nelumbo (Minnesota Bot. Studies,* Ser. II., Part 5, p. 645–55, Pl. 48–50) made a further investigation desirable. Having already considerable material in hand with a view to a careful study of the genus (which is approaching completion), I have examined the mature and germinating embryos of several species, and studied the development in three members of widely differing sub-genera, viz., *N. odorata* Ait., *N. cærulea* Sav., and *N. Lotus* L. The course of events seems identical in all of these. A suspensor of three to five cells in linear series is formed, upon which a 'spherical embryo' of some hundreds of cells develops as described by Mr. Lyon for *Nelumbo*. This is embedded in a soft mass of endosperm at the micropylar end of the ovule; three fourths of the length of the seed is occupied with perisperm. The spherical embryo, however, unlike that of *Nelumbo,* gives rise to two opposite and symmetrical outgrowths near its lower end. These become the two equal cotyledons. The intervening apical portion of the sphere becomes the plumule, with the rudiments of two unequally developed leaves. The basal portion of the sphere becomes the radicle. At maturity the embryo exhibits two thick, concave, hemispherical cotyledons, applied against each other all round by their edges; while the central concavity is occupied by the plumule. The endosperm is now reduced to a single layer of cells and a line of thin crushed walls between these and the cotyledons. A large amount of oil is stored in the embryo and endosperm, with a little starch and some proteid. The perisperm is densely packed with starch.

It seems necessary, in view of these facts, to modify Mr. Lyon's classification of Nymphæaceæ among the Helobiæ. If we are to consider the development of *Nelumbo* as strictly monocotyledonous, then it must be separated as a distinct order, as some writers have already placed it. However, we would prefer to interpret the peculiar embryogeny of *Nelumbo* as a modified form of dicotyledony. The symmetry of the early embryonic vascular system supports this view; and the decurrence of the cotyledons around the radicle is paralleled in *Tropœolum.* Further, a complete fusion of the cotyledons along one edge has been noted in *Nuphar lutea* by Hegelmaier, as quoted by Henslow, and a much more pronounced 'pseudo-monocotyledony' is seen in *Trapa natans, Ranunculus ficaria,* etc. A number of striking examples and suggestions in this connection are followed up by Henslow in his paper on 'A Theoretical Origin of Endogens from Exogens' in *Journ. Linn. Soc.,* London, 29; 485–528, and in his 'Origin of Plant Structures,' pp. 136–79. Mr. Lyon's observations have numerous interesting bearings on Henslow's theory.

Henry S. Conard.

University of Pennsylvania.

WILLIAM LE ROY BROUN.

Dr. William Le Roy Broun (M.A., LL.D.), president of the Alabama Polytechnic Institute, died suddenly on January 23. He was one of the foremost educators of the country, and, from time to time, had been prominently associated with the leading educational institutions in the South.

In recent years he was conspicuous for the great work he accomplished as a pioneer in the field of technical education. Since 1884 he had been president of the Alabama Polytechnic Institute, and under his wise and progressive guidance this institution had been developed into a highly successful and widely known college of applied science. His death will be an immense loss to the cause of Southern, indeed of national, education.

He was a native of Virginia, born in Loudon county, 1827, and a distinguished Master of Arts of the University of Virginia, where he was a fellow student and an intimate friend of a group of prominent Southerners, including Dr. J. A. Broadus, William Wirt Henry, Professor Frank Smith of the University of Virginia, and others. Dr. Broun was graduated in 1850. He was elected to the professorship in the college of Mississippi in 1852 and stayed there two years, then to the chair of mathematics in the University of Georgia.

In 1856 Dr. Broun founded Bloomfield Academy near the University of Virginia, which he conducted successfully until the outbreak of the war between the States. In 1859 he married Miss Sallie J. Fleming, daughter of a prominent Virginia family. She has been dead a number of years.

Dr. Broun enlisted in the Confederate army as a lieutenant of artillery. He rose to the rank of lieutenant colonel in the Ordnance Department, and on account of his high mathematical and scientific attainments was made Commandant of the Arsenal in Richmond. He, perhaps, gave the last order in that city directing the blowing up of the Confederate Arsenal.

After the close of the war Dr. Broun was elected to the chair of physics in the University of Georgia, and in 1872 he became president of the Agricultural and Mechanical College of that University. From 1875 to 1882 he was professor of mathematics in Vanderbilt University, Nashville, Tenn., and in 1882 was elected president of the Agricultural and Mechanical College of Alabama, now known as the Polytechnic Institute. He remained in Auburn one year and went to the University of Texas as professor of mathematics, where he was made chairman of the faculty. In 1884 Dr. Broun was reelected president of the Alabama Polytechnic Institute at Auburn. He had served continuously as president of the institution since 1884.

Dr. Broun was a man of varied and accurate scholarship and of rare wisdom in the control of a great institution. Broadly founded in the principles of educational science, he always planned wisely, and was the first to establish and to develop several new branches of scientific education in the South, such as manual training, electrical engineering and biology.

SCIENTIFIC NOTES AND NEWS.

PLANS have been formed for the erection of a memorial tower and meteorological station in honor of Dr. J. P. Joule, F.R.S., at Sale, Cheshire, where he lived from 1872 to the time of his death in 1880.

DR. ED. SUESS, professor of geology at Vienna, has been made an honorary member of the Academy of Sciences at St. Petersburg.

M. ALFRED PICARD has been elected a member of the Paris Academy of Sciences.

THE Prince of Wales has been admitted as a fellow of the Royal Society.

DR. J. R. GREEN, the well-known botanist, has been elected a fellow of Downing College, Cambridge.

DR. WILHELM HITTORF, professor of physics at Münster, celebrated the fiftieth anniversary of his professorship on January 12. He was on the occasion made an honorary doctor of engineering of the Technical School at Charlottenburg.

THE twenty-fifth anniversary of the professorship of Augusto Tamburini, professor of psychiatry at the University of Modena, was celebrated on December 25, by the presentation of a medal and other ceremonies.

PROFESSOR ERNST VON LEYDEN, the eminent pathologist at the University of Berlin, will celebrate his eightieth birthday on April 20.

DR. KARL PIESKE, engineer in the hydrological bureau in Berlin, has been given the title of 'professor.'

DR. C. H. HERTY, of the University of Georgia, will shortly resign to accept a position in the bureau of forestry.

PROFESSOR A. C. HADDON, of Cambridge University, has been appointed advising curator of the Horniman Museum at Forest Hill, now under the charge of the London County Council.

DR. ADOLF MEYER, the new head of the Pathological Institute of the New York State

Hospitals, has recommended the reappointment of Dr. P. H. Levine as head of the chemical department and of Dr. Brooks as associate in bacteriology.

It is stated in *Nature* that Professor E. Millosevich has succeeded Professor P. Tacchini as director of the Astronomical Observatory of the Roman College and of the astronomical museum connected with it. Professor Tacchini has resigned his office of administrator in the Reale Accademia dei Lincei, and Professor Volterra has been appointed as his successor. Professor P. Villari having been unable to accept the office as president, an election to the presidential chair will be made early in June.

Mr. W. S. Bruce, the leader of the Scottish Antarctic expedition, has secured the services of Captain Thomas Robertson, who for the last twenty years has sailed regularly every spring to the Arctic regions and once to the Antarctic.

Sir W. E. Garstin has started for the Sudan to examine the upper reaches of the Blue Nile and the Atbara. He expects also to visit Lake Tzana, in Abyssinia.

M. Hugues Le Roux, the French explorer and civil engineer, is in the United States for the purpose of delivering lectures. His first lecture in New York will be given on March 18, before the Geographical Society.

The Royal College of Physicians of London has appointed Dr. D. Ferrier, F.R.S., to be Harveian orator, Dr. Cullingworth to be Bradshaw lecturer, and Dr. H. T. Bulstrode to be Milroy lecturer.

Professor Willis L. Moore, chief of the Weather Bureau, lectured at Wesleyan University on February 18, his subject being 'Storm Phenomena.'

The British Association of Technical Institutions held its annual meeting on January 31, when Lord Avebury was elected president for the ensuing year, and delivered an address, in which he dwelt on the neglect of modern languages and science in the system of education.

Dr. H. A. Giles, professor of Chinese at the University of Cambridge, will give a series of lectures at Columbia University, beginning on March 5. They inaugurate the new department of Chinese, established at the University by General Charpentier with an endowment of over $200,000.

The death is announced of Dr. Robert Adamson, professor of logic and rhetoric at Glasgow University and the author of numerous contributions to philosophy, including works on 'Roger Bacon' and on the 'Philosophy of Science in the Middle Ages.'

Dr. C. M. Guldberg, professor of mathematics at Christiania, died on January 14, aged sixty-five years.

Mme. Clémence Royer has died at Paris at the age of seventy-two years. She first became known as the translator of Darwin's 'Origin of Species,' to which she prefixed an important introduction. She was the author of numerous works and articles on philosophy, ethics and natural science.

Dr. Thomas Neall Penrose, medical director, United States Navy, retired, died on February 13, aged sixty-seven years.

Captain Cheyne, R. N., who was present as an officer with the three Arctic expeditions that went in search of Sir John Franklin, has died in Halifax, N. S., on February 9, in his seventy-fifth year.

Mr. Alfred William Bennett, a well-known English botanist, died on January 23. According to a notice in the London *Times* he was born at Clapham, in 1833, and was educated at University College, London. The first of his more important contributions to scientific literature was editing, with Mr. Thiselton Dyer, the English edition of Sachs's 'Textbook of Botany,' 1875; in 1889 he published, in conjunction with Mr. G. Murray, a 'Handbook of Cryptogamic Botany'; his most popular work was the 'Flora of the Alps,' which appeared about seven years ago. He was a fellow of the Linnean Society and of the Royal Microscopical Society, the *Journal* of which society was edited by him.

In a recent number of Science it was stated that the collection of Aino objects made by

Professor Bashford Dean in Japan was 'purchased' for the American Museum of Natural History. It should have been said that the museum reimbursed Professor Dean for the sum which he advanced in making the purchases, and that he contributes as his share in the collection his field expenses and services.

A BILL appropriating $50,000 to enable Professor John B. Smith of Rutgers College to make experiments for the eradication of mosquitoes has been reported favorably in the New Jersey legislature.

THE position of assistant in pathology with a salary of $840 and of assistant in physiology at a salary of $1,000 in the Bureau of Plant Industry, Department of Agriculture, will be filled by civil service examination on February 26.

A TELEGRAM has been received at the Harvard College Observatory from Professor W. W. Campbell at Lick Observatory stating that Professor Perrine finds that the remarkable coronal disturbance in the Sumatra eclipse was immediately above the prominent and only sunspot visible during eleven days.

AT the meeting of the Connecticut Academy of Sciences on February 12, Professor A. E. Verrill exhibited several remarkable photographs in natural colors, made direct from nature by a new autochromatic process, invented by Mr. A. Hyatt Verrill of New Haven. One of these photographs was a Bermuda landscape in which the beautiful tints of the water, etc., were well brought out. Three other plates were copies of water-color drawings of brilliantly colored Bermuda fishes. The photographic reproduction of these showed accurately all the delicate shades of green, blue, pink, purple, yellow and orange. The intense red colors appear to be the most difficult to render by this process at present, but no doubt this will soon be remedied by further experiments now in progress.

THE third annual Charter Day meeting of the Sigma Xi Society at the University of Nebraska was held on February 14. Professor Samuel Calvin, of the University of Iowa and director of the Iowa Geological Survey, was the guest of the Society at the annual banquet and delivered the annual address on 'Records of the Great Ice Age in the Upper Mississippi Valley.' The lecture, which was illustrated by lantern slides, presented the important discoveries of the speaker on the precise limits and characteristics of the various ice sheets which have been demonstrated as present during the ice age in Iowa and the adjacent States.

Nature reports that at the recent annual general meeting of the Royal Scottish Arboricultural Society, Lord Mansfield said he was authorized to state that it was Mr. Hanbury's intention to appoint a departmental committee to inquire into and report upon the present position and future prospects of forestry and the planting and management of woodlands in the United Kingdom, and to consider whether any further measures might be taken with advantage, either by the provision of further educational facilities or otherwise, for their promotion and encouragement. Mr. Munro-Ferguson, M.P., has been invited and has consented to act as chairman of the committee.

THE London *Times* states that the recent acquisitions to the zoological department of the British Museum of Natural History include the interesting collections made by Sir Harry Johnston in Uganda. The great interest attaching to the discovery of the now celebrated okapi has overshadowed the rest of the collection forwarded to the museum by Sir Harry. It contained, nevertheless, many specimens of considerable scientific interest. Mr. Oldfield Thomas, the mammalogist of the department, has been unable to separate specifically the five-horned giraffe obtained near Mount Elgon from the ordinary North African form. The specimen has unusually developed horns, and on that account is of special interest. The collection of birds, though small in number, was particularly welcome, since it was made up chiefly of big birds, such as vultures, storks and herons. Travelers, as a rule, will not take the trouble to skin and bring home birds of this description. The fishes also proved to be very valuable, as they were the first specimens received from Lakes Victoria and Baringo. They included two specimens new to science, described by Mr. Boulenger.

UNIVERSITY AND EDUCATIONAL NEWS.

It will be remembered that several citizens offered to give the Johns Hopkins University a new site in the northern suburbs, consisting of 176 acres, on condition that a million dollars be raised for the erection of buildings. It is understood that the condition has been withdrawn and that the land will be presented to the University at the celebration on Feb. 22.

Cooper Union, New York City, has received an anonymous gift of $250,000 to be added to the endowment.

The sum of £5,000 has been bequeathed to the Aberdeen University, to be applied to the purposes of the University at the discretion of the senate, by the late Surgeon-General Robert Harvey.

Improvements have been completed in the Rotch Building at Harvard University during the last few months which add largely to its facilities for the study of mining engineering. A gift from J. J. Storrow, '85, has made possible the entire refitting of the laboratory of metallurgical chemistry. A new laboratory, to be known as the 'Simpkins Assay Laboratory,' has been fitted up in a large room in the addition on the east side, and another, the 'Simpkins Metallurgical Laboratory,' which is now being equipped, will occupy the remainder of this section. A large room in the northwest corner of the building is to be used for the study of steel; and a complete set of machinery is being installed for this purpose. The laboratory of metallography has been moved to the old Infirmary Building.

A fire in the anatomical laboratory of the University of Minnesota on January 25, caused a loss of $10,000. The students saved the valuable libraries of Professors Erdman and Reed, but some collections were destroyed.

Professor Victor Vaughan, dean of the Medical College of the University of Michigan, is chairman of a committee composed of representatives from the leading schools of the United States, whose object is to make it possible for a system of credits to be standardized in all these schools, so that a student in any one of them may transfer to any other without loss of standing. The colleges represented on the committee are Michigan, Harvard, Pennsylvania, Johns Hopkins, Columbia and Western Reserve.

It is officially announced that law students in Germany need no longer hold a certificate from a classical gymnasium, but may be graduates of the Realgymnasia or higher Realschulen.

The Dowager-Empress of China has issued an edict which, after pointing out that many Chinese have studied abroad formerly, but that no Manchus have done so, orders the Manchu clan at Court and the generals of eight banners to nominate Manchus of between 15 and 25 to go abroad to study foreign branches of knowledge.

Lord Curzon, the viceroy of India, has appointed a commission to visit the university centers and colleges of India to inquire into their prospects, report on their working, and recommend measures for the improvement of the teaching and the standard of learning. The commission is composed as follows: Mr. T. Raleigh, president; Syad Hossain Bilgrami Nawab; Mr. J. P. Hewett, Secretary to the Home Department; Mr. A. Pedler, Director of Public Instruction in Bengal; Professor A. Bourne, Principal of Madras College; and the Rev. Mr. Mackichan, Principal of Wilson College, Bombay.

Dr. R. W. Hall, at present instructor in biology at Yale University and at the Marine Biological Laboratory at Wood's Holl, has been engaged as instructor in biology at Lehigh University. Mr. E. A. Regestein (Massachusetts Institute, '99) has been appointed instructor in electrical engineering at Lehigh University.

Professor von Krafft-Ebbing is about to retire from the chair of psychiatry at Vienna and will be succeeded by Professor W. von Jauregg.

Mr. W. E. Johnson, of King's College, Cambridge, has been appointed Sidgwick lecturer in moral science.

Dr. Pierre Janet has been elected to the chair of psychology in the Collège de France vacant by the resignation of Professor Th. Ribot.

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, FEBRUARY 28, 1902.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*THE JOHNS HOPKINS UNIVERSITY COMMEMORATIVE ADDRESS.**

THIS is not the time, although it is a birthday, to review the infancy of this University. Reminiscences of the cradle and the nursery are profoundly interesting to a very small number of the near and dear, but according to a formula, which may be stated with mathematical precision, the interest varies inversely as the square of the distance.

It is meet and right and our bounden duty to commemorate the munificence of the founder, who in his grove at Clifton, and at his residence in town, spent the close of his life in perfecting a plan by which his fortune might be made to benefit humanity. Two noble purposes, the education of youth and the relief of suffering, —the Johns Hopkins University and the Johns Hopkins Hospital, became the objects of his thought and bounty. It would be pleasant to dwell upon the personalities of his early advisers,—three of whom may now witness our fervent congratulations. We might journey with them to Cambridge, New Haven, Ithaca, Ann Arbor, and Charlottesville, as they engaged in enquiries respecting the nature and offices of those leading universities, an example of

* By Daniel C. Gilman, President of the Johns Hopkins University from 1875 to 1901, on the occasion of the celebration of the twenty-fifth anniversary of the founding of the university.

original research, praiseworthy and beneficial. We might sit with them in a little room on North Charles Street, and listen to Presidents Eliot, Angell, and White as they were subjected to 'interviews,' recorded by the swift strokes of the stenographic pen, and now preserved in our archives. We might wonder by what process the Trustees selected a president, and be willing to learn what he said to them in his earliest conversation. It would gratify some curiosity to review the correspondence carried on with those who afterward became members of the faculty,—and with those who did not. It would be an extraordinary pleasure to the speaker on this occasion, to awaken the memories of those early days of unbounded enthusiasm and unfettered ideality, well described in a periodical by one who was here at the outset,—days which surprised and delighted intelligent observers.

These temptations must be avoided. The occasion is too important, the audience too varied, the visitors too many and too distinguished, to warrant the employment of this brief hour in personal reminiscences and local congratulations. We are rather bound to consider some of the grave problems of education which have engaged, during a quarter of a century, the study of able and learned men, and have led to the development, in this country, of the idea of the University. This period has seen marvellous improvements in higher education, and although, in the history of intellectual development, the nineteenth century may not be as significant as the thirteenth, when modern universities came into being at Bologna, Paris, and Oxford, yet we have lived at a time when forces have been set to work of the highest significance. Libraries, seminaries and laboratories have been enlarged and established in every part of the land.

Let us go back to the year 1876, that year of jubilee, when the centennial celebration in Philadelphia brought together, in open concord, states and peoples separated by dissension and war. Representatives from every part of the land assembled, in the City of Brotherly Love, to commemorate the growth of a century. The triumph of liberal and industrial arts, the progress of architecture, sculpture, and painting, were interpreted by the music of our Sidney Lanier. The year was certainly propitious. So was the place. Maryland was a central state, and Baltimore a midway station between the North and the South. The people had been divided by the war, but there were no battle fields in our neighborhood to keep in mind the strife of brethren. The State of Maryland had been devoted to the idea of higher education ever since an enthusiast in the earliest colonial days projected the establishment of a university on an island in the Susquehanna. Liberal charters had been granted to colleges, of which St. John's, the successor of the first free school, must have honorable mention, a college likely to be increasingly useful during the twentieth century. The University of Maryland, with scanty resources, encouraged professional training in law, medicine, and the liberal arts (nominally also, in theology), but its efforts were restricted by the lack of funds. Nathan R. Smith, David Hoffman and other men of eminence were in the faculty. The Catholic Church had established within the borders of the state a large number of important schools of learning. One of them, St. Mary's College, under the cultivated fathers of St. Sulpice, had been the training place of some of the original promoters of the Johns Hopkins University. Yet there was nothing within the region between Philadelphia and Charlottesville, between the Chesapeake and the Ohio, which embodied, in 1876, the idea of a true university. Thus it appears that the time, the place and the circumstances, were favorable to an endowment which seemed to be extraordinarily large, for the munificence of Rockefeller, Stanford and Carnegie could not be foreseen.

The founder made no effort to unfold a plan. He simply used one word,—UNIVERSITY,—and he left it to his successors to declare its meaning in the light of the past, in the hope of the future. There is no indication that he was interested in one branch of knowledge more than in another. He had no educational 'fad.' There is no evidence that he had read the writings of Cardinal Newman or of Mark Pattison, and none that the great parliamentary reports had come under his eye. He was a large minded man, who knew that the success of the foundation would depend upon the wisdom of those to whom its development was entrusted; and the Trustees were large minded men who knew that their efforts must be guided by the learning, the experience, and the devotion of the Faculty. There was a natural desire, in this locality, that the principal positions should be filled by men with whom the community was acquainted, but the Trustees were not governed by an aspiration so provincial. They sought the best men that could be found, without regard to the places where they were born, or the colleges where they had been educated. So, on Washington's birthday, in 1876, after words of benediction from the President of Harvard University, our early counsellor and our constant friend, the plans of this University were publicly announced in the President's inaugural speech.

As I cast my thoughts backward, memories of the good and great who have been members of our society rise vividly before us,—benefactors who have aided us by generous gifts, in emergencies and in prosperity; faithful guardians of the trust; illustrious teachers; and brilliant scholars who have proceeded to posts of usefulness and honor, now and then in Japan, in India, in Canada, but most of them in our own land, from Harvard to the Golden Gate.

I must not linger, but lead you on to broader themes. May I venture to assume that we are an assembly of idealists. As such I speak; as such you listen. We are also practical men. As such, we apply ourselves to useful purposes, and to our actions we apply the test of common sense. Are our aims high enough? are they too high? are our methods justified by experience? are they approved by the judgment of our peers? can we see any results from the labors of five and twenty years? can we justify a vigorous appeal for enlargement? These and kindred questions press themselves for consideration on this memorial day. But in trying to answer them, let us never lose sight of the ideal,—let us care infinitely more for the future than we do for the past. Let us compare our work with what is done elsewhere and with what might be done in Baltimore. In place of pride and satisfaction, or of regret that our plans have been impeded, let us rejoice that the prospects are so encouraging, that the opportunities of yesterday will be surpassed to-morrow.

If it be true that 'the uses of Adversity' are sweet,—Adversity that 'wears yet a precious jewel in his head,' let us look forward to leaving our restricted site for a permanent home where our academic life will be 'exempt from public haunt,' where we shall 'find tongues in trees, books in the running brooks, sermons in stones, and good in every thing.' In faith and hope and gratitude, I have a vision of Homewood, where one person and another will build the structures of which we stand in so much need,—where scholarship will have its quiet retreat, where experimental science will be removed from the jar of the city street, where health and vigor will be promoted by athletic sports in the groves of Academus. The promised land which Moses sees from Pisgah, our Joshua will possess.

Some curious parallels, familiar to the readers of history, may here be brought to mind. Thrice, in three centuries, great universities have arisen with their healing influence at the close of long wars. In familiar language, Motley tells us how the university of Leyden was established by the Dutch Republic, after the fearful siege which that brave city had endured. On the 5th of February, 1575, three hundred years before our natal day, the city of Leyden crowned itself with flowers, and 'with harmless pedantry, interposed between the acts of the longest and dreariest tragedy of modern times,' celebrated the new foundation. Allegorical figures moving in procession escorted the orator of the day, the newly appointed professors and other dignitaries, to the cloister of Saint Barbara where with speech and banquet they celebrated the day. Ever since, Leyden has been a noble seat of learning, and many of our own countrymen in early days resorted to it. The university of Berlin was established after the humiliation of Prussia by the Napoleonic wars. William von Humboldt has many titles to fame,—but none of his laurels are so fresh as the wreaths which crown his brow as the founder of that great university to which so many of the foremost scholars of Europe have been called, from F. A. Wolf to Van't Hoff. Within the memory of most of us, the university of Strasburg sprang into life at the close of the Franco-Prussian war. The German Emperor could see no better way of giving peace and prosperity to the captured province, than by making it the seat of a great university.

At the close of our civil war came the opportunity of Baltimore. It led to an extraordinary and undesigned fulfilment of an aspiration of George Washington. As his exact language is not often quoted, I venture to give it here. In his last will and testament, after expressing his ardent desire that local attachments and State prejudices should disappear, he uses the following words.

> "Looking anxiously forward to the accomplishment of so desirable an object as this is (in my estimation), my mind has not been able to contemplate any plan more likely to effect the measure, than the establishment of a University *in a central part of the United States,* to which the youths of fortune and talents from all parts thereof may be sent for the completion of their education, in all the branches of polite literature, in arts and sciences, in acquiring knowledge in the principles of politics and good government, and, as a matter of infinite importance in my judgment, by associating with each other, and forming friendships in juvenile years, be enabled to free themselves in a proper degree from those local prejudices and habitual jealousies which have just been mentioned, and which, when carried to excess, are never-failing sources of disquietude to the public mind, and pregnant of mischievous consequences to this country."

You will please to notice that he did not speak of a university in Washington, but of a university 'in the central part of the United States.' What is now the central part of the United States? Is it Chicago or is it Baltimore?

Let me now proceed to indicate the conditions which existed in this country when our work was projected. You will see that extraordinary advances have been made. The munificent endowments of Mr. John D. Rockefeller and of Mr. and Mrs. Leland Stanford,—the splendid generosity of the State legislatures in Michigan, Wisconsin, Minnesota, California, and other Western States, the enlarged resources of Harvard, Yale, Columbia, Princeton, Pennsylvania and other well established universities, and now the unique and unsurpassed generosity of Mr. Carnegie have entirely changed the aspects of liberal education and of scientific investigation.

As religion, the relation of finite man to the Infinite, is the most important of all human concerns, I begin by a brief reference to the attitude of universities toward Faith and Knowledge. The earliest universities of Europe were either founded by the Church or by the State. Whatever their origin, they were under the control, to a large extent, of ecclesiastical authorities. These traditions came to our country, and the original colleges were founded by learned and Godly men, most of them, if not all, the ministers of the gospel. Later, came the State universities and later still, the private foundations like that in which we are concerned. Gradually, among the Protestants, laymen have come to hold the chief positions of authority formerly held by the clergy. The official control, however, is less interesting at this moment than the attitude of universities toward the advancement of knowledge. To-day, happily, apprehensions are not felt, to any great extent, respecting the advancement of science. It is more and more clearly seen that the interpretation of the laws by which the universe is governed extending from the invisible rays of the celestial world to the most minute manifestations of organic life reveal one plan, one purpose, one supreme sovereignty—far transcending the highest conceptions to which the human mind can attain respecting this sovereign and infinite Power. Sectarian supremacy and theological differences have dwindled therefore to insignificance, in institutions where the supreme desire is to understand the world in which we are placed, and to develop the ablest intellects of each generation, subservient to the primeval injunction 'replenish the earth and subdue it; and have dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moveth upon the earth.' Notwithstanding these words, the new Biology, that is the study of living creatures, encountered peculiar prejudices and opposition. It was the old story over again. Geology, early in the century, had been violently attacked; astronomy, in previous centuries, met its bitter opponents; higher criticism is now dreaded. Yet quickly and patiently the investigator has prosecuted and will continue his search for the truth, —heedless of consequences, assured by the Master's words,—'the Truth shall make you free.'

Still the work goes on. Science is recognized as the handmaid of religion. Evolution is regarded by many theologians as confirming the strictest doctrines of predestination. The propositions which were so objectionable thirty years ago are now received with as little alarm as the propositions of Euclid. There are mathematicians who do not regard the Euclidean geometry as the best mode of presenting certain mathematical truths, and there are also naturalists who will not accept the doctrines of Darwin, without limitation or modification, but nobody thinks of fighting over the utterances of either of these philosophers. In fact, I think it one of the most encouraging signs of our times that devout men, devoted to scientific study, see no conflict between their religious faith and their scientific knowledge. Is it not true that as the realm of Knowledge extends the region of Faith though restricted remains? Is it not true that Science to-day is as far from demonstrating certain great propositions, which in the depths of our souls we all believe, as it was in the days of the Greek philosophers? This university, at the outset, assumed the position of a fearless and determined investigator of nature. It carried on its work with quiet, reverent, and unobtrusive recognition of the immanence of divine power,—of the Majesty, Dominion, and Might, known to men by many names, revered by us in the words that we learned from our mothers' lips, Almighty God, the Father everlasting.

Another danger, thirty years ago, was that of conflict between the advocates of classical and scientific study. For many centuries Greek and Latin were supreme in the faculty of liberal arts, enforced and strengthened by metaphysics and mathematics. During the last half century, physical and natural sciences have claimed an equal rank. The promotion has not been yielded without a struggle, but it is pleasant to remember that in this place, no conflict has arisen. Among us, one degree, that of Bachelor of Arts, is given alike to the students of the Humanities and the students of Nature and the degree of Doctor of Philosophy may be won by advanced work in the most remote languages of the past or in the most recent developments of biology and physics. Two illustrious teachers were the oldest members of the original faculty;—one of them universally recognized as among the foremost geometricians of the world,—the other, renowned for his acquaintance with the masters of thought in many tongues, and especially for his appreciation of the writers of ancient Greece, upon whose example all modern literature is based.

Our fathers spoke of 'Church and State,' and we but repeat their ideas when we say that universities are the promoters of pure religion and wise government. This university has not been identified with political partisanship,—though, its members, like all patriots, have held and expressed their opinions upon current questions, local and national. Never have the political views of any teacher helped or hindered his preferment; nor have I any idea what would be the result of the party classification of our staff. This, however, may be claimed. The study of politics, in the sense of Freeman, 'History is past politics, and politics present history,' has been diligently promoted. The principles of Roman law, international arbitration, jurisprudence, economics, and institutional history have here been set forth and inculcated,—so that in every part of the land, we can point to our graduates as the wise interpreters of political history, the strong promoters of democratic institutions, the firm believers in the merit system of appointments, and in local self-government.

A phrase which has lately been in vogue is original research. Like all other new terms, it is often misapplied, often misunderstood. It may be the highest occupation of the human mind. It may be the most insignificant. A few words may therefore be requisite to explain our acceptance of this word. When this university began, it was a common complaint, still uttered in many places, that the ablest teachers were absorbed in routine and were forced to spend their strength in the discipline of tyros, so that they had no time for carrying forward their studies or for adding to human knowledge. Here the position was taken at the outset that the chief professors should have ample time to carry on the higher work for which they had shown themselves qualified, and also that younger men, as they have evidence of uncommon qualities, should likewise be encouraged to devote themselves to study. Even those who were candidates for degrees were taught what was meant by profitable investigation. They were shown how to discover the limits of the known; how to extend, even by minute accretions, the realm of knowledge; how to cooperate with other men in the prosecution of enquiry; and how to record in exact language, and on the printed page, the results attained. Investigation has thus been among us the duty of every leading professor, and he has been the guide and inspirer of fellows and pupils, whose work may not bear his name, but whose results are truly products of the inspiration and guidance which he has truly bestowed.

The complaint was often heard, in the early seventies, that no provision was made in this country for post-graduate work except in the three professional schools. Accordingly, a system of fellowships, of scholarships, and of other provisions for advanced study was established here, so well adapted to the wants of the country at that time that its provisions have been widely copied in other places. It now seems as if there was danger of rivalry in the solicitation of students, which is certainly unworthy, and there is danger also that too many men will receive stipendiary encouragement to prepare themselves for positions they can never attain. In the early days of the French Academy when a seat in that body was a very great prize, a certain young man was told to wait until he was older, and the remark was added that in order to secure good speed from horses, a basket of oats should always be tied to the front of the carriage pole as a constant incitement. It would indeed be a misfortune if a system of fellowships should be open to this objection. Nevertheless, whoever scans our register of Fellows will discover that many of the ablest men in the country, of the younger generation, have here received encouragement and aid.

When this university began the opportunities for scientific publication in this country were very meager. The *American Journal of Science* was the chief repository for short and current papers. The memoirs of a few learned societies came out at slow intervals and could not be freely opened to investigators. This university in the face of obvious objection determined to establish certain journals which might be the means of communication between the scholars of this country and those abroad. Three journals were soon commenced: The *American Journal of Mathematics;* the *American Journal of Philology;* the *American Chemical Journal.* Remember that these were 'American' journals, in fact as well as in name, open to all the scholars of the country. Other periodicals came afterwards, devoted to History and Politics, to Biology, to Modern Languages, to Experimental Medicine and to Anatomy. Moderate appropriations were made to foreign journals, of great importance, which lacked support, the English *Journal of Physiology* and the German *Journal of Assyriology.* Nor were the appropriations of the Trustees restricted to periodical literature. Generous encouragement was given to the publication of important treatises, like the researches of Dr. Brooks upon *Salpa;* to the physiological papers of Dr. Martin; to the studies in logic of Mr. Peirce and his followers; to Professor Rowland's magnificent photographs of the solar spectrum; to the printing of a facsimile of the earliest Christian document after the times of the Apostles; and recently, with the cooperation of the University of Tübingen, to the exact reproduction by Dr. Bloomfield of a unique manuscript which has an important bearing upon comparative philology.

I am not without apprehensions that our example to the country has been infelicitous, not less than thirty institutions being known to me, which are now engaged in the work of publication. The consequence is that it is almost impossible for scholars to find out and make use of many important memoirs, which are thus hidden away. One of the problems for the next generation to solve is the proper mode of encouraging the publication of scientific treatises.

I cannot enumerate the works of scholarship which have been published without the aid of the university by those connected with it,—studies in Greek syntax, in mathematics, in history, in chemistry, in medicine and surgery, in economics, in pathology and in many other branches. The administration now closing can have no monument more enduring than the great mass of contributions to knowledge, which are gathered (like the cairn of boulders and pebbles which commemorates in Cracow, the burial place of Kosciusko), a bibliothecal cairn, in the office of the Trustees, to remind every officer and every visitor of our productivity in science and letters.

There are many who believe that the noblest work in which we have engaged is the advancement of medical education and science. Several agencies have been favorable. The munificence of the founder established a hospital, which was recognized as soon as it was opened, as the foremost of its kind in Christendom. He directed that when completed it should be a part of the University and, accordingly, when the time came for organizing a medical and surgical staff, the principal professors were simultaneously appointed to the chairs of one institution, to the clinics of the other. They were to be constantly exercised in the relief of suffering and in the education of youth. For the lack of the requisite funds, the University at first provided only for instruction in those scientific branches which underlie the science of medicine. At length, the organization of the school of medicine was made possible by a very large gift of money, received from a lady of Baltimore, who was familiar with the requirements of medical science, and eager to see that they were met. By her munificence the University was enabled to organize and maintain that great department, which now reflects so much honor upon this city and which does so much by example, by publication, by systematic instruction, and by investigation to carry forward those varied sciences, anatomy, physiology, physiological chemistry, pharmacy, pathology, and the various branches of medicine and surgery. In accordance with the plans of the University, the generous donor made it a condition of her gift that candidates for the degree of Doctor of Medicine should be those only who had taken a baccalaureate degree based upon a prolonged study of science and the modern languages. A four years' course of study was also prescribed and women were admitted to the classes upon the same terms as men. The liberal and antecedent aid of women throughout the country in the promotion of these plans is commemorated by a building inscribed 'the women's fund memorial building.' The excellent laboratory facilities, the clinical opportunities, the organization of a training school for nurses, and especially the ability of the physicians and surgeons have excited abundant emulation and imitation in other parts of the country,—a wonderful gain to humanity. It is more and more apparent among us that a medical school should be a part of a university and closely affiliated with a hospital. It is also obvious that the right kind of preliminary training should be antecedent to medical studies.

I must ask the indulgence of our friends from a distance as I now dwell, for a moment, on the efforts which have been made to identify the Johns Hopkins University with the welfare of the city of Baltimore and the State of Maryland. Such a hospital and such medical advisers as I have referred to are not the only benefits of our foundation. The journals, which carry the name of Baltimore to every learned society in the world are a minor but serviceable advantage. The promotion of sanitary reform is noteworthy, the study of taxation and in general of municipal conditions, the purification of the local supply of water, the advancement of public education by courses of instruction offered to teachers, diligent attention to the duties of charity and philanthropy, these are among the services which the faculty have rendered to the city of their homes. Their efforts are not restricted to the city. A prolonged scientific study of the oyster, its life history, and the influences which help or hinder its production, is a valuable contribution. The establishment of a meteorological service throughout the State in connection with the Weather Bureau of the United States is also important. Not less so is the Geological Survey of Maryland, organized with the cooperation of the United States Geological Survey, to promote a knowledge of the physical resources of the State, exact maps, the improvement of highways, and the study of water supplies, of conditions favorable to agriculture, and of deposits of mineral wealth, within this region. To the efficiency of these agencies it is no doubt due that the State of Maryland has twice contributed to the general fund of the university.

Nor have our studies been merely local. The biological laboratory, the first establishment of its kind in this country, has carried forward for many years the study of marine life at various points on the Atlantic and has published many important memoirs, while it has trained many able investigators now at work in every part of the land. Experimental psychology was here introduced. Bacteriology early found a home among us. The contributions to chemistry have been numerous and important. Here was the cradle of Saccharine, that wisely diffused and invaluable concentration of sweetness, whose manufacturers unfortunately do not acknowledge the source to which it is due. In the physical laboratory, light has been thrown upon three fundamental subjects:—the mechanical equivalent of heat, the exact value of the standard ohm, and the elucidation of the nature of the solar spectrum. For many years this place was the chief seat in this country for pure and advanced mathematics. The study of languages and literature, oriental, classical, and modern, has been assiduously promoted. Where has the Bible received more attention than is given to it in our Semitic department? where the study of ancient civilization in Mesopotamia, Egypt, and Palestine? where did the Romance languages, in their philological aspect first receive attention? To American and institutional history, persistent study has been given. Of noteworthy significance also are the theses required of those who are admitted to the degree of Doctor of Philosophy, which must be printed before the candidate is entitled to all the honors of the degree.

I might enlarge this category, but I will refrain. The time allotted to me is gone. Yet I cannot sit down without bringing to your minds the memories of those who have been with us and have gone out from us to be seen no more: Sylvester, that profound thinker devoted to abstractions, the illustrious geometer whose seven prolific years were spent among us and who gave an impulse to mathematical researches in every part of this country; Morris, the Oxford graduate, the well trained classicist, devout, learned, enthusiastic, and helpful, most of all in the education of the young; accomplished Martin, who brought to this country new methods of physiological enquiry, led the way in the elucidation of many problems of profound importance, and trained up those who have carried his methods to every part of the land; Adams, suggestive, industrious, inspiring, versatile, beneficent, who promoted, as none had done before, systematic studies of the civil, ecclesiastical, and educational resources of this country; and Rowland, cut down like Adams in his prime, honored in every land, peer of the greatest physicists of our day, never to be forgotten in the history of physical science. I remind you also of the early student of mathematics, Thomas Craig, and of George Huntington Williams, the geologist, whose memory is cherished with admiration and love. Nor do I forget those who have here been trained to become leaders in their various departments throughout the country. One must be named, who has gone from their number, Keeler, the gifted astronomer, who died as the chief of the Lick Observatory in California, whose contributions to astronomical science place him among the foremost investigators of our day; and another, the martyr Lazear, who, in order that the pestilence of yellow fever might be subdued, gave up his life for humanity.

Like clouds that rake the mountain summit,
Or waves that own no curbing hand,
How fast has brother followed brother
From sunshine to the sunless land.

It is sad to recall these interrupted careers. It is delightful to remember the elevated character of those I have named, and delightful to think of hundreds who have been with us, carriers to distant parts of our country and to other lands of the seeds which they gathered in our gardens of science. It is delightful to live in this age of bounty; it is delightful to know that the citizens of Baltimore who in former years have supplemented the gifts of the founder by more than a million of dollars have come forward to support a new administration with the gift of a site of unsurpassed beauty and fitness. A new day dawns. "It is always sunrise somewhere in the world."

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*INAUGURAL ADDRESS.**

It has been said that 'old men tell of what they have seen and heard, children of what they are doing, and fools of what they are going to do.' Your speaker, fearing to furnish data that may suggest to you his place in this system of classification, prefers this morning to deal with matters that are largely independent of time.

The American University as distinguished from the College is a comparatively recent product of evolution—or of creation. Being young, its character is not fully developed, and we can only speculate in regard to its future. On an occasion of this kind, when one of the young universities of the country is celebrating in a quiet way the twenty-fifth anniversary of its foundation, and when a new presiding officer makes his first appearance before a large assembly, it seems fitting that he upon whom has been placed the responsibility of guiding, for the present, the affairs of the University, should take the opportunity thus afforded of giving expression to a few thoughts that suggest themselves when one begins to reflect upon the significance of the University movement in this country. Everyone at all acquainted with educational matters knows that the differentiation of the University from the College is the most characteristic fact in the history of higher education during the past quarter century. It is well that we should ask ourselves, What does this tendency mean? Whither is the movement likely to carry us?

While, from the beginning, the authorities of the Johns Hopkins University have maintained a collegiate department as well as a graduate or university department, and have endeavored to make this as efficient as possible under existing circumstances, the subjects that present themselves in connection with this branch of our work are so familiar and have been so much discussed that I can pass over them now without danger of giving the impression that we consider these subjects of less importance than those more directly connected with the work of the University. At all events, in what I shall have to say, I propose to confine myself to the latter.

* By President Remsen, on the occasion of his inauguration as President of the Johns Hopkins University.

The idea that a student who has completed a college course has something yet to learn, if he chooses the career of a teacher or scholar, does not appear until quite recently to have taken strong hold of the minds of those who had charge of the educational interests of our country. Perhaps it would be better to put it in this way: They do not appear to have thought it worth while to make provision in the system for those who wanted more than the college gave. The college has for its object the important work of training students for the duties of citizenship, not primarily the duties of scholarship, and no one doubts that, in the main, they have done their work well. Nor does any one doubt that, whatever may come, the college has a leading part to play in this country. Collegiate work by its very nature necessarily appeals to a much larger number than university work. But college work requires no apologist nor defender. It appeals strongly to the American people, and it is well that this is so. The college is in no danger of annihilation, though the indications are that it will undergo important modifications in the future as it has in the past. Upon this subject much might be said, and I feel strongly tempted to enlarge upon it, notwithstanding the intention already expressed of confining myself to problems more directly connected with the university proper.

There is, however, one phase of the college problem that is so closely connected with that of the university that I cannot avoid some reference to it. There is a marked and rapidly growing tendency to make college work the basis of the work in professional schools. As is well known, some of our medical schools now require a college degree for admission. The average age of graduation from our leading colleges is so high that the students cannot begin their professional courses until they are from twenty-two to twenty-three years of age on the average. Then, too, the length of the professional courses is greater than it formerly was, so that some of the best years of life are taken up in preparatory work. One thing seems to admit of no denial, and that is that, in so far as it prevents students from beginning their professional studies or their work in business life until they have attained the age of twenty-two or twenty-three, our present system is seriously defective. The defect is one that must be remedied. Various efforts are now being made looking to improvement, but it is not yet clear how this problem will be solved.

In this country the name university in the new sense is frequently applied to one department, and that is the philosophical department. This has to deal with philology, philosophy, history, economics, mathematics, physics, geology, chemistry, etc.; in short, it comprises all branches that do not form an essential part of the work of the departments of medicine, law and theology. A fully developed university, to be sure, includes at least four departments—the medical, the legal, the theological, and the philosophical; or, in other words, the university faculty comprises faculties of medicine, of law, of theology and of philosophy.

The new thing in educational work in this country is the philosophical faculty of our universities.

This meets the needs of those students who, having completed the college course, and having, therefore, had a good general training that fits them for more advanced study, wish to go forward in the paths of learning, and, so far as this may be possible, to become masters of some special branch. Most of these students are preparing to teach in colleges and elsewhere, so that the philosophical department of the University is to-day a professional school just as much as the medical or the legal department. On the completion of the college course, the student holds the same relation to the philosophical department of the university as to the other departments, or to the professional schools, and the age question is fully as important in the case of the student in the philosophical faculty as in the case of those who are to enter the professional schools. Now, if it be conceded that the training of specialists—not necessarily narrow specialists, but necessarily those who are thoroughly grounded in some one subject—I say, if it be conceded that the training of specialists is essential to the growth of the highest scholarship, then by advancing the age of graduation from our colleges, we are interfering with the development of scholarship in the highest sense, because the greater the age of graduation from the colleges the less will these graduates be inclined, or be able, to take up the advanced work that is essential to convert them into scholars. But let me close what I have to say on this subject by the safe prediction that the time will come when the work of our colleges will be adjusted to the work of the various faculties of the university so that the passage from the one to the other will not involve something unnatural—either hardship to the student or a telescoping of college and university which now on the whole furnishes the best way out of the existing difficulty.

I have said that the new thing in educational work in this country is the philosophical faculty of our universities. The growth of the work of the philosophical faculty has, however, undoubtedly influenced that of the other faculties—more particularly the medical. Gradually the medical schools, those connected with the universities at least, are adopting university standards. The same is true to some extent of schools of law and of theology, so that, I think, it is safe to assert that the great activity that has characterized the work of the philosophical faculties of our universities has tended in no small measure to the improvement of the work of our professional schools. It has lifted them to a higher level, and that is a result that the world at large may congratulate itself upon.

One of the most remarkable facts in connection with what we may call the development of the university idea in this country, is the surprisingly rapid increase in the attendance upon the courses offered by our philosophical faculties during the last few years. In what I shall have to say I shall for the present use the term graduate student in the restricted sense which it has come to have, meaning a college graduate who is following courses offered by the philosophical faculty of some university, and excluding, therefore, those who are studying medicine, or law, or theology in universities.

I have recently asked the United States Commissioner of Education to help me answer the following questions:

1. How many graduate students were in the United States in the year 1850?

2. How many in 1875, and

3. How many in 1900?

The answers are these:

1. In 1850 there were 8 graduate students in all the colleges of the country. Of these 3 were enrolled at Harvard, 3 at Yale, 1 at the University of Virginia and 1 at Trinity College.

2. In 1875 the number had increased to 399.

3. In 1900 the number was 5,668.

At present the number cannot be far from 6,000.

In order that these facts may be properly interpreted we should know how many Americans are studying in foreign universities. The records show that in 1835 there were 4 American students in the philosophical faculties of German universities; in

1860 there were 77; in 1880, 173; in 1891, 446; in 1892, 383; in 1895, 422, and in 1898, 397.

These figures show clearly that the increase in the attendance at American universities is not accounted for by a falling off in attendance at German universities. On the other hand, they do show that for the last ten years at least there has been no increase in the attendance at German universities, but rather a slight decrease.

Six thousand students are, then, to-day pursuing advanced courses in our American universities, while not longer ago than 1875 the number was only about 400. In this connection it must further be borne in mind that during this period the colleges have not relaxed in their requirements. The tendency has been in the opposite direction. So that it means to-day more rather than less than it did in 1875 to be a graduate student. That there is an increasing demand for university work is clear and it seems to be destined to play a more and more important part in the development of our educational methods.

Now, what is the cause of the rapid increase in the demand for university work, or the rapid increase in the attendance upon university courses? No simple answer would be correct. Probably the principal direct cause is the increased demand on the part of the colleges, and to some extent of the high schools, for teachers who have had university training. The degree of Doctor of Philosophy being the outward and visible sign of such training, many colleges have virtually taken the ground that none but Ph.D.'s need apply. This would, of course, tend directly to increase the attendance at the universities. Operating in the same way is the multiplication of chairs in the colleges. While not long ago one man often taught a number of subjects, sometimes related, sometimes not, the college authorities are coming more and more to entrust a single subject to a single man. The old-fashioned professor who could teach any subject in the curriculum with equal success is a thing of the past except in a few remote regions. The university-trained man has largely taken his place, and the universities are spreading their influence into the nooks and corners of the country through these men.

I need not discuss this phase of the subject further. It will, I am sure, be acknowledged without argument that it is desirable that our college faculties should be made up of men who have enjoyed the best educational advantages. In supplying such men the universities are doing a work of the highest value for the country. If nothing else were accomplished by our universities they would be worthy of all the support they get. The results of their work in this direction are not as tangible as that of the work of the colleges, for the latter reach much larger numbers and in ways that can be more easily followed. But if we keep in mind the fact that the college is dependent upon the university for its faculty and that the character of the college is in turn dependent upon the character of its faculty, it will be seen that whatever good may come from the college is to be traced directly to work done by the universities. In order to keep our colleges up to a high standard it is absolutely necessary that our universities should be maintained on a high plane. This university work is not something apart, independent of other kinds of educational work. It is a necessary part of the whole system. It affects not only our colleges, but our schools of all grades, and must, therefore, have a profound influence upon the intellectual condition of the whole country. It is difficult, perhaps, to prove this, but it seems to me that the statements just made are almost self-evident truths.

But the universities are also doing another kind of work of importance to the country. Through their specially prepared men they are doing something to enlarge the bounds of knowledge. To be sure, such work is also being done to some extent in our colleges and elsewhere, but the true home of the investigator is the university. This work of investigation is as important as the work of training men. What does it mean? All persons with healthy minds appear to agree that the world is advancing and improving. We see evidences of this on every side. Those results that appeal most strongly to mankind are, perhaps, the practical discoveries that contribute so much to the health and comfort of mankind. These are so familiar that they need not be recounted here. If great advances are being made in the field of electricity, in the field of medicine, in the field of applied chemistry, it is well to remember that the work that lies at the foundation of these advances has been done almost exclusively in the universities. It would be interesting to trace the history of some of these advances. We should find that in nearly every case the beginning can be found in some university workshop where an enthusiastic professor has spent his time prying into the secrets of nature. Rarely does the discoverer reap the tangible reward of his work—that is to say, he does not get rich—but what of it? He has his reward, and it is at least a fair question whether his reward is not higher than any that could be computed in dollars and cents.

The material value to the world of the work carried on in the university laboratories cannot be over-estimated. New industries are constantly springing up on the basis of such work. A direct connection has been shown to exist between the industrial condition of a country and the attitude of the country towards university work. It is generally accepted that the principal reason why Germany occupies such a high position in certain branches of industry, especially those founded upon chemistry, is that the universities of Germany have fostered the work of investigation more than those of any other country. That great thinker and investigator, Liebig, succeeded during the last century in impressing upon the minds of his countrymen the importance of encouraging investigations in the universities, and since that time the German laboratories of chemistry have been the leaders of the world. In Germany the chemical industries have grown to immense, almost inconceivable, proportions. Meanwhile the corresponding industries of Great Britain have steadily declined. This subject has recently been discussed by Arthur C. Green in an address read before the British Association at its meeting at Glasgow last summer. The address has been republished in SCIENCE, volume 2, page 7, of 1902. I call the attention especially of our business men to this address. I think it will show them that university work in some lines at least is directly and closely connected with the industrial position of a country. Speaking of the coal-tar industry, the author of the paper referred to says: "In no other industry have such extraordinarily rapid changes and gigantic developments taken place in so short a period—developments in which the scientific elucidation of abstract problems has gone hand in hand with inventive capacity, manufacturing skill, and commercial enterprise; in no other industry has the close and intimate interrelation of science and practice been more clearly demonstrated." And further on: "Again, besides the loss of material wealth which the neglect of the coal-tar trade has involved to this country, there is yet another aspect of the question which is even of more importance than the commercial one. There can be no doubt that the growth in Germany of a highly scientific industry of large and far-reaching proportion has reacted with beneficial effect upon the universities, and has tended to promote scientific thought throughout the land. By its demonstration of the practical importance of purely theoretic conceptions it has had a far-reaching effect on the intellectual life of the nation. How much such a scientific revival is wanted in our country the social and economical history of the past ten years abundantly testifies. For in the struggle for existence between nations the battle is no longer to the strong in arm, but to those who are the strongest in knowledge to turn the resources of nature to the best account.''

What I want to make clear by these quotations and references is that universities are not luxuries, to be enjoyed or not, as we may please. They are necessities. Their work lies at the very foundation of national well-being.

But there is another aspect of university work of greater importance than that of which I have spoken. I mean the intellectual aspect in the highest sense. The world is advancing in other ways than along material lines. While as I have pointed out, the material interests of the world are connected with the intellectual condition, there are thoughts, there are ideas, that are above material considerations, ideas pertaining to the history of mankind, to the origin and development of the universe, to the phenomena of life, to the development of thought, to the significance of religions. All these are of importance, and the character of a nation is determined by the extent to which these ideas are cultivated. There is call for investigation in every subject—in the various branches of philology, in history, in economics, in archæology, as well as in the natural sciences, and here again the universities furnish the workers and the workshops.

There are, then, deep-seated reasons for encouraging the work of our universities in every possible way. We cannot afford to let them languish. The interests involved are too great. The more clearly this is recognized the better for us.

The rapid advances that have been made in university work in this country have brought us somewhat suddenly face to face with new educational problems, and we have not yet had time to adjust ourselves to the new situation thus created. We are in the experimental stage. We are trying to determine how we ought to deal with our graduate students in order to get the best results; how, in general to make the work as efficient as possible.

As one who, with others, has been engaged for twenty-five years in studying the new problems and in attempting to solve them, I may be permitted to say a few words in regard to one of the most important problems that the universities have to deal with at present. I refer to the problem of the professors. Having been a professor for about thirty years, and having during that time known intimately many of those who belong to this class and worked with them, I feel that I may speak of the professor problem with some confidence.

The university is what the professors make it, and the president has no more important duty to perform than that of seeing that the various chairs are filled by the right kind of men. He should not take the full responsibility of selection. He should take all the good advice he can get. He is sure to have some that is bad. He should, however, not only take advice, but he should endeavor to determine for himself by every available means whether or not the persons recommended to him are worthy of appointment. He should not shirk this responsibility. A mistake in this line is almost as difficult to rectify as a mistake in the matrimonial line—perhaps more difficult. It is, therefore, doubly important that an appointment should be made with great deliberation and with a full realization of the gravity of the act. It is not, however, the process of appointing that I wish especially to speak of, though much that is interesting to university circles might be said on this subject. It is rather the principles that are involved. What constitutes a good professor? What kind of men are the universities looking for? Is the supply of this kind of men equal to the demand? These are some of the questions that suggest themselves in this connection. Let me attempt to answer them briefly.

The development of universities in this country has created a demand for a kind of professor somewhat different from that demanded by the college. It would not be difficult to describe the ideal university professor, but we should gain little in this way. I shall assume that he has the personal traits that are of such importance in those who are called upon to teach. A man of bad or questionable character, or of weak character, is no more fit to be a university professor than to be a college professor or a teacher in a school. That is self-evident. At least it seems so to me. Leaving these personal matters out of consideration, the first thing that is essential in a university professor is a thorough knowledge of the subject he teaches and of the methods of investigation applicable to that subject; the second is the ability to apply these methods to the enlargement of the field of knowledge; and the third is the ability to train others in the use of these methods. But a knowledge of the methods, the ability to apply them, and the ability to train others in their use, will not suffice. The professor, if he is to do his duty, must actually be engaged in carrying on investigations both on his own account and with the cooperation of his most advanced students. This is fundamental. It may be said, and this cannot be denied, that there is much research work done that is of little value to the world, that, in fact, much of that which is done by our graduate students is trivial judged by high standards. It would be better, no doubt, if every professor and every advanced student were engaged upon some problem of great importance to the world. But this is out of the question in any country. Few men possess that clearness of vision and that skill in devising methods, combined with the patience and power of persistent application that enable them to give the world great results. If only those who can do great things were permitted to work, the advancement of knowledge would be slow indeed. The great is built upon the little. The modest toiler prepares the way for the great discoverer. A general without his officers and men would be helpless. So would the great thinker and skillful experimenter without the patient worker, 'the hewer of wood and drawer of water.'

Of so-called research work there are all grades. A man may reveal his intellectual power as well as his mental defects by his investigations. But it remains true that the university professor must be carrying on research work or he is failing to do what he ought to do. It is part of his stock in trade. He cannot properly train his students without doing such work and without helping his students to do such work. One of the best results of carrying on this research work is the necessary adoption of world standards. A man may teach his classes year after year and gradually lose touch with others working in the same branch. Nothing is better calculated to keep him alive than the carrying on of a piece of work and the publication of the results in some well-known journal. This stimulates him to his best efforts, and it subjects him to the criticism of those who know. He may deceive his students and himself—no doubt he often does—but he cannot deceive the world very long. The professor who does not show what he can do in the way of adding to the knowledge of the world, is almost sure to become provincial when he gets away from the influence of his leaders.

Other things being equal, the professor who does the best work in his special branch is the best professor. The universities want leaders. Unfortunately, the number of these is quite limited, and it is not surprising that there are not enough to go round. It is becoming very difficult to find properly qualified men to fill vacant university professorships. Given sufficient inducements and it would be quite possible to 'corner the market.' There are at least half a dozen, probably more, universities in this country on the lookout for young men of unusual ability. They are snapped up with an avidity that is a clear sign of the state of the market. One of the greatest obstacles in the way of the advancement of our American universities to-day is a lack of enough good professorial material. Fortunately, the universities are themselves providing the means by which this obstacle may be overcome, though not as rapidly as we should like. That is, however, not the fault of the universities. Some deeper cause is operating. Nature does not seem to supply enough raw material. It is often raw enough, to be sure, but its possibilities are limited.

This, too, suggests another question of deep import for the intellectual development of our country. Do our ablest men enter universities and engage in advanced work? This is a question which it is very difficult, if not quite impossible, to answer. I think it is not uncommonly assumed that they do not; that our ablest men, our best thinkers, are not in the universities. It is often said that they are in the law or in business. It may be. Certainly the great jurists and the great business men seem to be relatively more numerous than the great university teachers. I should not think it worth while to touch upon this subject were it not for the fact that recently the suggestion has been made that some of the men who become great in other lines might be induced to enter the academic career if only sufficient inducements were offered. The proposition is that a marked increase in the emoluments of professors would tend to attract some of the best material from other fields. I do not feel sure of this. In any case, the subject is hardly worth discussing. Whatever improvement is to come will come slowly, and this is fortunate. A sudden increase of the salaries of the leading professors of this country to, say, $10,000 or more, would not suddenly change the status of these professors among their fellow men, and, while the professors might be pleased, and probably would be, the main question is, Would this change have any effect in the desired direction? Speculation on this subject seems to me of no value. If it be true that the men of the best intellects do not find their way into university circles, it is safe to assume that this is due to a great many conditions, and that the conditions are improving. The intellectual standards of our colleges and universities are gradually being raised. We cannot force matters.

The best thing we can do for our students is to give them good professors. Sumptuous laboratories, large collections of books and apparatus, extensive museums are well enough. They are necessary, no doubt. But I fear they are too much emphasized before the public. A university is, or ought to be, a body of well-trained, intelligent, industrious, productive teachers of high character provided with the means of doing their best work for their students, and therefore for the world.

The Johns Hopkins University cannot live on its past, however praiseworthy that past may have been. If the contemplation of the past has the effect of stimulating us to our best efforts, it is a profitable occupation. If it lulls us into inactivity, it is fatal. We should not, nor can we, escape criticism for present misdeeds by referring to a glorious past. We have, to be sure, inherited certain ideals that we should cherish. So, also, we have probably done things that we ought not to have done, and the study of our past may help us to see where we have made mistakes and to show us how to avoid them in the future. There is only one way to make a university what it ought to be, and that is by doing good work according to the highest standards. Professors and students must cooperate in this. With the right professors we shall have this cooperation. Students have the power of collective judgment that is probably fairer than the judgment of any individual. They will work well if their masters work well. The professor is teaching all the time. His duty to his students is not done when he dismisses them from the lecture room or the laboratory. His influence for good or evil is continuous and lasting.

Will you allow me a few personal words? Those of you who know most of the occurrences of last year know best that the office, the duties of which I formally assume to-day, came to me unexpectedly and against my wishes. My life up to the present has been spent as a teacher. I ask no higher occupation. There is none more rewarding. It would have been agreeable to me to continue in this occupation to the end. Indeed, even as matters now stand, I hope it will not be necessary for me to withdraw entirely from the work to which my life has thus far been devoted. On the other hand, I recognize to the full the importance of the new work to which I have been called, and I accept the new duties with the intention of using every effort to further the interests of this University. Having taken the step, I accept the responsibility. I cannot permit anything to interfere with the work of the presidency. I believe, however, that I shall not be obliged to give up that which is dear to me in the science of chemistry.

In conclusion, I wish to express my hearty thanks to my distinguished predecessor, to my colleagues, to the students of the University, and to this community for the kindness with which they have accepted my election. I could not ask for better treatment. In return, I can only promise to do all that in me lies to make this University worthy of its history, to make it as helpful as possible, not only to this community, of which I am proud to be a member, but to the State and to the country. It is my earnest wish, as I am sure it is yours, that the period upon which the University now enters may be at least as useful as that which now ends.

We have passed through a time of great anxiety. Causes have been in operation that have of late seriously interfered with our development. It is not strange that the world at large should have received the impression that the Johns Hopkins University has seen its best days. The fact is that the doleful stories that have been going the rounds have a slight basis. It is this: The growth of the University has been temporarily checked. It has not gone backward, but, for a time at least, it has stood still. I believe that a new day has at last dawned and that the onward march will soon be taken up. Our difficulties have by no means been overcome, but a magnificent beginning has been made. The public spirit and generosity of William Wyman, of William Keyser, of Samuel Keyser, of Francis M. Jencks, of William H. Buckler and Julian Le Roy White, are worthy of the highest commendation. These high-minded men have started the new era. They have shown their confidence in the work of the University and set an example to their fellow men. I would not detract in the least from the praise due to every one of these gentlemen, but I am sure the others whom I have named will pardon me if in conclusion I exclaim, Long live William Wyman and William Keyser!

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*PRESENTATION OF CANDIDATES FOR HONORARY DEGREES.**

To the Assembly:

From time immemorial, it has been the custom of universities at festive celebrations, to bestow upon men of learning, personal tokens of admiration and gratitude. In conformity with this usage, our university desires to place upon its honor list the names of scholars who have been engaged with us in the promotion of literature, science and education. In accordance with the request of the Academic Council and in their name, I have the honor and the privilege of presenting to the President of the Johns Hopkins University those whose names I shall now pronounce, asking their enrolment as members of this 'Societas magistrorum et discipulorum.'

To the President:

Mr. President: In the name of the Academic Council, I ask that several scholars, who pursued advanced studies under our guidance, without proceeding to degrees, be now admitted to the degree of Master of Arts, *honoris causâ*, and assured of our hearty welcome to this fraternity.

William Thomas Councilman,
Benjamin Ives Gilman,
John Mark Glenn,
Clayton Colman Hall,
Theodore Marburg,
William L. Marbury,
Robert Lee Randolph,
Lawrason Riggs,
Henry M. Thomas,
Julian Le Roy White.

Mr. President: I have now the honor of presenting to you, one by one, a number of eminent men, recommended by a committee of the professors, and of asking you to admit them to the degree of Doctor of Laws, *honoris causâ*, in the Johns Hopkins University.

Three of these scholars were friends and counsellors of the Trustees before any member of this Faculty was chosen. They pointed out the dangers to be avoided, the charts to be followed, and during seven and twenty years they have been honored friends, by whose experience we have been guided, by whose example we have been inspired.

Charles William Eliot, President of Harvard University, oldest and most comprehensive of American institutions,—the Chief, whose wisdom, vigor, and devotion to education have brought him honors which we gladly acknowledge, which we cannot augment.

James Burrill Angell, teacher, writer, diplomatist, scholar, excellent in every calling, whose crowning distinction is his service in developing the University of Michigan, a signal example of the alliance between a vigorous state and a vigorous university.

Andrew Dickson White, honored Ambassador of the United States in Germany, the organizer of Cornell University, whose diplomatic success increases the distinction he had won as an able professor, a learned historian, and a liberal promoter of science, literature and art.

With these early friends, I now present to you several men who have been associated with us in carrying on the work of this University:—

John Shaw Billings, able adviser of the Trustees of the Johns Hopkins Hospital respecting its construction, an authority on the history of medicine, a promoter of public hygiene, a famous bibliographer and the wise administrator of public libraries in the City of New York.

Granville Stanley Hall, who planned and directed the first laboratory of experimental psy-

* On behalf of the University, by Dr. D. C. Gilman, President Emeritus, on the occasion of the celebration of the twenty-fifth aniversary of the founding of the University.

chology in the United States, and who left a professorship among us to become first President of Clark University in Worcester,—a learned and inspiring philosopher, devoted to the education of teachers in schools of every grade from the lowest to the highest.

James Schouler, successful lecturer and writer on law and history, a lover of truth, a diligent explorer of the historical archives of this country, author of a history of the United States, comprehensive and trustworthy.

John William Mallet, of the University of Virginia, one of that brilliant band of lecturers to whom we listened in the winter of 1876–77, an ornament of the University founded by Jefferson, where scholars of every birthplace are made to feel at home; where two of our earliest colleagues had been professors. He is a chemist of international renown, whose researches are an enduring contribution to the science that he professes.

Charles Doolittle Walcott, Superintendent of the United States Geological Survey, a government bureau of the highest standing, that extends its investigations to every part of the land, securing for other States, as it does for Maryland, an accurate knowledge of the structure and resources of the earth. The chief of this survey is a geologist whose administrative duties have not prevented his personal devotion to scientific research in which he maintains acknowledged eminence.

Simon Newcomb, professor of mathematics in the United States Navy, once professor here, who has carried forward the researches initiated by Copernicus. His astronomical memoirs, above the ken of ordinary minds, have caused his name to be enrolled in the learned academies of Europe among the great investigators of celestial laws.

I have now the honor to present to you two scholars from a neighboring commonwealth, the Dominion of Canada, the representative of the University of Toronto, and the representative of McGill University in Montreal, who came to rejoice with us in this our festival,—James Loudon and William Peterson. We welcome them in the brotherhood of scholarship which knows of no political bounds, appreciating what they have done to uphold the highest standards of education in two great universities, with which we are closely affiliated.

It is not easy to discriminate among our own alumni, so many of whom we honor and admire, but on this occasion I have been asked to present four candidates, all of whom are widely known as scholars.

Josiah Royce, a graduate of the University of California, one of the first to be called to a fellowship among us, and one of the first four Doctors of Philosophy in this University, Doctor Subtilis, now Professor in Harvard University, Gifford lecturer in two of the Scotch universities, historian, man of letters, and philosopher.

John Franklin Jameson, of the University of Chicago, one of the most accurate and serviceable students of the Constitutional History of this country, an editor of historical papers, whose rare erudition is always placed at the command of others in a spirit of generous cooperation.

Edmund B. Wilson, of Columbia University, a profound investigator and an acknowledged authority in biological science,—one of the men not seen by the outer world, who look deeply into the fundamental laws of organic life.

Woodrow Wilson, of Princeton University, writer and speaker of grace and force, whose vision is so broad that it includes both north and south, a master of the principles which underlie a free government, whom we would gladly enrol among us a Professor of Historical and Political Science.

I now present to you nine men, the number of the muses, each of whom, like others already presented to you, is a leader of higher education,—two from New England, two from the Central States, two from the far South, one from the Northwest, and two from the Pacific coast. These are all our collaborators,—sentinels on the watch towers, heralds of the dawn.

Francis Landey Patton, under whose presidency 'old Nassau Hall,' the College of New Jersey, has become the University of Princeton, revered as a preacher of righteousness, admired as an Abelard in dialectics, beloved as an inspiring teacher of theology and philosophy.

William Rainey Harper, interpreter of the Sacred Scriptures, a fearless leader, a skillful organizer, who has brought into the front rank the University of Chicago.

Charles William Dabney, of the University of Tennessee, a man of science, and Edward A.

ALDERMAN, of Tulane University in New Orleans, a man of letters,—two leaders in the advancement of education in the South, advocates of schools and colleges of every grade, and their zealous promoters.

NICHOLAS MURRAY BUTLER, whose enthusiasm, energy, and knowledge of the principles and methods of Education have given him distinction throughout the land and have led to his promotion to the presidency of Columbia University in the city of New York.

HENRY SMITH PRITCHETT, astronomer and geodesist, who went from his home in Missouri to distant lands, now to observe an eclipse, now a transit, who has been the distinguished head of the United States Coast Survey, and is now the head of a vigorous foundation in Boston, the Massachusetts Institute of Technology.

I present to you the two representatives of learning and scholarship in 'the new world beyond the new world,' a Grecian and a student of Natural History, BENJAMIN IDE WHEELER, President of the University of California,—an idealist worthy to represent the aspirations of Berkeley, and DAVID STARR JORDAN, the naturalist, who has led in the organization of the Stanford University, chiefs of two harmonious institutions, one of which was founded by private bounty, the other by the munificence of a prosperous State.

As this roll began with Harvard it ends with Yale. I present to you finally one of the strongest and most brilliant of this strong and brilliant company,—ARTHUR TWINING HADLEY, a writer and thinker of acknowledged authority on the principles of finance and administration, the honorable successor of Timothy Dwight as President of Yale University.

THE CHICAGO MEETING OF THE AMERICAN PHYSIOLOGICAL SOCIETY.

THE American Physiological Society held its fourteenth annual meeting at the University of Chicago, December 30 and 31, 1901. Notwithstanding the fact that the Society had hitherto met only in the East, there was a large attendance of members, and great interest was shown in the proceedings. The following new members were elected, making the total membership ninety-seven: Harvey B. Cushing, A.M., M.D., Associate in Surgery, Johns Hopkins University; Joseph Erlanger, M.D., Instructor in Physiology, Johns Hopkins University; Martin H. Fischer, M.D., Associate in Physiology, University of Chicago; Arthur W. Greeley, A.M., Assistant in Physiology, University of Chicago; E. Mark Houghton, Ph.C., M.D., Lecturer on Experimental Pharmacology in the Detroit College of Medicine; H. S. Jennings, Ph.D., Assistant Professor of Zoology, University of Michigan; Waldemar Koch, Ph.D., Assistant in Pharmacology, University of Chicago; David J. Lingle, Ph.D., Instructor in Physiology, University of Chicago; Elias P. Lyon, Ph.D., Assistant Professor of Physiology, University of Chicago; E. Lindon Mellus, M.D., Baltimore; George B. Wallace, M.D., Instructor in Pharmacology, University and Bellevue Hospital Medical College, New York. The Council for the past year was reelected, viz., Professors R. H. Chittenden, W. H. Howell, Frederic S. Lee, W. P. Lombard and W. T. Porter. The Council subsequently reelected as president Professor Chittenden, and as secretary and treasurer Professor Lee.

The scientific program was an unusually full one, thirty-two papers being presented. A considerable number of demonstrations, especially of new apparatus, were also made. Only a very brief outline of the program can be indicated here.

The Relation of Blood-plates to the Increase in the Number of Red Corpuscles at High Altitudes: Professor G. T. KEMP, University of Illinois.

The red corpuscles and the blood-plates were counted at Paris, and found to number, respectively, 4,800,000 and 457,000 per cubic millimeter. Seventy-two hours later, the final twenty-four hours of which were spent at Görner Grat, Switzerland, the respective numbers were 7,000,000 and 1,206,-900. The plates had thus increased much more than the red corpuscles. The predominance of plates of large size was very striking; the number of small red corpuscles was much greater than is seen in normal blood. The whole appearance suggested the *crise hématoblastique* of Hayem. The most careful search, however, failed to reveal plates colored by hæmoglobin.

Some New Observations on Blood-plates: Professor G. T. Kemp and O. O. Stanley.

The experiments of Dutjen have been repeated, and his statement corroborated, viz., that the plates exhibit amœboid movements when examined in proper media. From preparations made from the blood of animals, into whose circulation methylene blue had been injected, and examined by Dutjen's method, and from others studied by Macallum's method for the detection of phosphorus, the authors conclude that the plates consist of nucleo-proteid existing as granules scattered through the clear mass (of protoplasm?), which is capable of exhibiting amœboid movements.

Notes on the Physiology of the Circulatory System in the Hagfish, Polistotrema stouti: Professor C. W. Greene, University of Missouri.

The California hagfish possesses three well-developed hearts, the systemic heart, the portal heart and the caudal heart. The systemic heart is different from that in all craniate vertebrates so far examined, in that it possesses no regulative nervous system. The portal heart also is devoid of such a system. The caudal heart propels blood from the great lateral subcutaneous sinuses into the caudal vein. It was proved that these sinuses normally contain blood, and not lymph alone. The blood of the hagfish has a concentration very close to that of the sea water in which the animal lives. The lowering of the freezing point of hagfish serum is 1.934° C.—1.992° C., while that of sea water in Monterey Bay is 1.945° C.

The Mechanism of Fibrillar Contraction of the Heart: Professor W. T. Porter, Harvard.

On Further Experiments on the Importance of Sodium for the Heart-Beat: Dr. D. J. Lingle, University of Chicago.

Heart stimulants like caffein can not make strips of muscle from the ventricle contract, unless sodium chloride is present. A recovery from the standstill induced by sodium chloride alone occurs in oxygen gas and in solutions containing hydrogen peroxide, as well as in various salt solutions. Heart strips placed first in a solution of sodium chloride, and then transferred to oxygen gas contract as long and as well as they do in a solution of calcium or other salts.

On the Prolongation of the Life of Unfertilized Eggs of the Sea-urchin by Potassium Cyanide: Professor Jacques Loeb, University of Chicago, and Mr. Lewis.

Death is an active process due to enzyme action. Fertilization greatly retards it. In the eggs of the sea-urchin brief treatment with certain salts, such as potassium cyanide, acts like fertilization to retard the mortiferous processes.

The Action of Alcohol on Muscle: Professor Frederic S. Lee, Columbia, and Dr. William Salant.

A frog's muscle which has absorbed a moderate quantity of ethyl alcohol will contract more quickly, relax more quickly, perform a greater number of contractions in a given time, and do more work than a muscle without alcohol, while the onset of fatigue is at the same time delayed. In larger quantities alcohol is detrimental, diminishing the whole number of contractions, inducing early fatigue and diminishing the amount of work that the muscle is capable of doing, even to the extent of doing away entirely with contractile power. In moderate quantities the alcohol is, at least temporarily, beneficial; in larger quantities poisonous. After-effects have not yet been studied.

The Excretion of Lithium: Mr. C. A. GOOD. (Presented by Professor A. R. Cushny, University of Michigan.)

Lithium chloride injected hypodermically in poisonous doses is excreted in large quantities by the alimentary tract. It is here that the chief symptoms of poisoning arise.

On the Question whether Dextrose is Produced from Cellulose in Digestion: Professor GRAHAM LUSK, New York University.

The feeding of cellulose in the form of paper to diabetic goats does not cause an increase of sugar in the urine; therefore, dextrose is not a product of the digestion of cellulose.

Experiments on the Relation Between the Spleen and the Pancreas: Professor L. B. MENDEL, Yale, and L. F. RETTGER.

These experiments were performed on dogs, and show that the extract of the spleen aids the transformation of the zymogen of the pancreas into trypsin. Similar results were obtained both within the living body and outside. The observations support the Schiff-Herzen hypothesis.

The Role of the Cell Nucleus in Oxidation and Synthesis: R. S. LILLIE. (Presented by Professor W. T. Porter, Harvard.)

New Experiments on Allantoin Excretion: Professor L. B. MENDEL, Yale.

Rectal injections of thymus gland substance in dogs were followed by characteristic excretion of allantoin in the urine. The diet was free from constituents yielding purin. Vegetable nucleic acids and nucleates from wheat germs experience transformations in metabolism comparable with those obtained from nucleins of animal origin. Allantoin and uric acid are excreted in noticeable quantity. Other physiological actions were studied after the introduction of nucleic acid into the circulation.

Studies on Diuresis: Dr. J. T. HALSEY, McGill.

Nussbaum's experiments on the circulation in and the function of the frog's kidney have been repeated, and it has been found that in the kidney in which the renal arteries have been tied some glomeruli are still supplied by the blood. In such cases the blood supply is so small that such glomeruli may be considered as physiologically negligible quantities. It seems a necessary conclusion that the substances which are excreted by the kidney under these conditions are excreted by the epithelium of the uriniferous tubules.

An Unrecognized Feature of Diuresis: Professor A. R. CUSHNY, University of Michigan.

The author's experiments had led to a conclusion somewhat the opposite of that of the preceding paper. Excretion occurs in the uriniferous tubules, but chlorides and water are excreted there much more readily than sulphates, phosphorus or urea.

The Physiological Effects of the Electrical Charge of Ions, and the Electrical Character of Life Phenomena: Professor JACQUES LOEB, University of Chicago.

The author has found that the stimulating power of chemical substances varies directly with the valence of the substance. The paper reviewed also some of the author's previous work in the light of recent discoveries, and maintained that vital phenomena, in general, are caused by the electrical charges of ions.

The Nature of Nerve Stimulation, and Alterations of Irritability: Professor ALBERT P. MATHEWS, University of Chicago.

The irritability of nerve protoplasm varies inversely with the stability of the hydrosol state of its colloids. Stimulation is gelation, and is brought about by negative electrical charges. Chemical stimulation is really an electrical stimulation due to the charges which the ions bear. Negative charges stimulate, positive charges prevent stimulation. The nerve impulse is due to a progressive precipitation of colloids by negative charges, the negative charges being regenerated by the precipitation of each succeeding mass of colloids. The negative variation, in other words, stimulates each successive segment of the nerve, and is regenerated by the change it produces in the colloids. Anæsthetics prevent precipitation. It is not the valence, in ultimate analysis, which produces stimulation, but the movement of the charge, chemical stimulation being thus identical with stimulation by light.

The Effect of Potassium Cyanide and Lack of Oxygen on the Fertilized Eggs of the Sea-urchin, Arbacia: Professor E. P. LYON, University of Chicago.

During each cleavage of the egg (tested to the third), there is a period of slight resistance to potassium cyanide and to lack of oxygen, followed by a period of much greater resistance. The period of least resistance comes about ten minutes after fertilization, and almost immediately after each succeeding cleavage.

Experiments with Zygadenus venenosus: Professor REID HUNT, Johns Hopkins.

The author has made a chemical and physiological study of this poisonous plant. He has isolated an alkaloid or a mixture of alkaloids having most of the chemical and physiological characteristics of veratrine.

Demonstration of the Glands in the Oviduct of the Fowl: Professor A. R. CUSHNY, University of Michigan.

Four varieties of glands have been found, secreting, respectively, albumen, the soft membrane, the hard shell, and, apparently, mucus. The last variety has been hitherto undescribed. They are interposed between those secreting albumen and those secreting the soft membrane.

An Attempt to Obtain Regeneration of the Spinal Cord: Dr. PERCY M. DAWSON and EDWIN N. RIGGINS, Johns Hopkins.

The animal, a young bitch, was nursed with the greatest care for one hundred and twelve days after the operation. Although the healing was *per primum,* with very little formation of scar-tissue, there was never any conclusive clinical evidence of conscious sensation, or of voluntary motion in the parts of the body supplied by the cord posterior to the section.

The Formula for Determining the Weight of the Central Nervous System in Frogs of Different Sizes: Professor H. H. DONALDSON, University of Chicago.

It was shown that in the case of the bull-frog and leopard frog, the weight of the central nervous system (brain and spinal cord) was a function of the body-weight and length of the frog, combined.

If the weight of the central nervous system (in milligrams) $= N$;
length of the entire frog (in millimeters) $= L$;
weight of the body (in grams) $= W$;
and the constant coefficient $= C$;
then:

$$N\,1\,(\sqrt[4]{L}\log W)\,C.$$

In the case of the bull-frog $C = 30$.
In the case of the leopard-frog $C = 27.5$.

The Chemical Analysis of the Brain: DR. W. KOCH, University of Chicago.

This paper was a preliminary report on the chemical analysis of nervous tissues, including methods for preparing cerebrin, cephalin and lecithin, in sufficient quantity for subsequent work.

The Study of Metabolism in a Case of Lymphatic Leukœmia: DR. YANDELL HENDERSON, Yale.

In a typical case of lymphatic leukæmia, with the white corpuscles at 300,000 and the red corpuscles only 2,500,000, there was no increase in the excretion of nuclein decomposition products (uric acid and P_2O_5). The pathological condition, therefore, seems to be due, not to an increased nuclein metabolism, in general, but to a diminished katabolism. As nearly all the leukocytes are lymphocytes, this seems to be due to an arrest in their development—*i. e.*, they are not transformed, as normally, into other forms of white cells.

The Mode of Action of Certain Substances on the Colored Blood Corpuscles, with Special Reference to the Relation between So-called Vital Processes and the Physico-Chemical Structure of the Cells: Professor G. N. STEWART, Western Reserve University.

On the Surface Action of Metals: Professor F. G. NOVY, University of Michigan.

The author has studied with Professor Freer the conditions favoring the formation of organic peroxides. In Nef's method of preparing benzoyl acetyl peroxide, the reagents, benzaldehyde and acetic anhydride, are mixed with sand and exposed in a thin layer to the action of air, with the result that auto-oxidation takes place, and the peroxide is formed. That this change is one of surface action was demonstrated in various ways. If a strip of paper is introduced into the mixture, the yield of peroxide is increased by more than 200 per cent. Strips of cloth and various metals were tested in like manner, and gave similar results, showing that the rate of formation of this peroxide depends on surface action, and varies within wide limits with the kind of surface employed.

Demonstrations of apparatus for teaching and for research were made by Professors W. P. Lombard, University of Michigan; W. T. Porter, Harvard; W. S. Hall, Northwestern University; Graham Lusk, New York University and Bellevue Hospital Medical School; and G. P. Dreyer, University of Illinois.

FREDERIC S. LEE.

SCIENTIFIC BOOKS.

TWO NEW WORKS ON MOSQUITOES.

A Monograph of the Culicidæ, or Mosquitoes, mainly compiled from the collections at the British Museum from various parts of the world, in connection with the investigation into the cause of malaria conducted by the Colonial Office and the Royal Society. By FRED V. THEOBALD, M.A., F.E.S., London. Printed by order of the Trustees of the British Museum. 1901. 3 vols. Pp. 424, 391, pl. 37 + 5, text figures 318.

Mosquito Brigades and How to Organize Them. By RONALD ROSS, F.R.C.S., D.P.H., F.R.S. London, Geo. Philip & Son. 1902.

The literature of mosquitoes is becoming enormous. The number of scientific papers published about these insects in the last three years has been very great and is increasing almost daily. It is safe to say, however, that two books which will be greeted with the greatest pleasure by thousands of people who have become interested in the mosquito question are those the titles of which have just been given.

When the Royal Society, at the request of the Right Honorable Joseph Chamberlain, appointed a committee to cooperate with the officials of the Colonial Office in the investigation of the causes of malaria and the possibility of controlling that scourge of tropical lands, one of the first steps of the committee was to secure the services of Mr. F. V. Theobald to prepare an illustrated monograph of the family Culicidæ, based upon the collections of the British Museum and upon the collections sent in by private individuals and collectors throughout the world. The date when this work was placed in Mr. Theobald's hands is not mentioned, but his work has certainly been done in little more than two years, and the results are displayed in the three volumes mentioned. The material at his disposal has been larger than has ever been brought together elsewhere and he has described in detail, with synoptical tables of subfamilies, genera and species, 340 species of Culicidæ, distributed in twenty-three genera, 108 of the species and 10 of the genera being new to science. Of the species, 131 belong to the old genus *Culex,* and of these 51 are new to science. Of the malaria-bearing genus *Anopheles,* 39 species are described, of which 12 are new to science. For North America 37 species are described, of which 5 are new, but the author calls especial attention to the fact that but little collecting of mosquitoes has been done upon the Pacific coast.

The end is by no means reached, since Ray Lankester, in his preface, states that collections are still arriving at the Museum, and it is to be hoped that this will continue for years to come; so that a supplementary volume will be necessary at no distant date to record additional species and correct present conclusions.

Mr. Theobald has given the world a remarkable monograph in a remarkably short space of time. His work is original in a high degree. In his preliminary matter, covering nearly a hundred pages, he enters extensively into the morphology of the group and its biology. He arrives at the interesting conclusion that the scale structure of these insects is one of the most important characters for both generic and specific distinction. This conclusion is of great importance, but is in a measure unfortunate for workers since it necessitates the use of a compound microscope in addition to the high-power hand lens for the proper separation of species. He establishes five new subfamilies of Culicidæ, namely, the Anophelina, the Culicina, Ædeomyina, Trichoprosoponina and Corethrina. It is unfortunate that these groups were not given the uniform subfamily *inæ* termination required by modern rules of zoological nomenclature, but after all this is a small point.

Especial care has been taken with the important subject of geographic distribution, and many interesting points have been brought out. As with other Diptera, these insects have apparently no great faunistic value, and many species, such as *Anopheles maculipennis, Culex pipiens, C. fatigans* and *Stegomyia fasciata,* are widespread.

The character and great number of the illustrations are worthy of especial commendation, and Mr. Theobald is heartily to be congratulated upon his great work; and the joint committee is to be congratulated as well upon the fact that it is able to secure a man who was able to perform this enormous task so successfully and in so short a space of time. The work is provided with a bibliography, defective in some respects, and with an index which might to advantage have been made somewhat more complete.

Realizing the necessity for concise and practical directions to communities, municipal and health organizations and individuals who wish to start a mosquito crusade, Major Ross, the distinguished investigator who first established the transfer of malarial parasites by mosquitoes and who has since directed the practical work which England has attempted to carry on in certain of her tropical colonies, has filled the want most excellently in his 'Mosquito Brigades.' The book is written by a man of highest scientific rank who is at the same time a practical man. His book is divided into sections, entitled, 'Things to be Learnt,' 'Things to be Done,' 'Summary,' 'Miscellaneous Remarks,' 'Appendix,' 'Books.' It is a handy little book of only 98 pages, but covers the ground in an admirable manner.

Taking the headings of his section, entitled 'Things to be Done,' for example, they are as follows: Appointment of Superintendent, The First Step, How to Raise Funds, Small Beginnings, Organization of the Brigade, Organization and Duties of the *Culex* Gang, Organization and Duties of the *Anopheles* Gang, Destruction of Larvæ, Destruction of Adults, Last Stages of the Campaign. This is followed by a summary of the objects and a summary of the methods, to which is appended a motto, which Dr. Ross thinks will shortly become the first law of tropical sanitation, namely *'No Stagnant Water.'* Major Ross's book is based upon experience gained during many years' study of mosquitoes in many parts of the world, and more especially upon the actual results of the operations now being carried on under the Liverpool School of Tropical Medicine, in West Africa. A great deal is said which applies chiefly to tropical regions, yet the book as a whole should be in the hands of every one in this country who is interested in the fight against mosquitoes.

In his section on sanitary anarchy Dr. Ross complains bitterly of the inertia of the sanitary and medical branches of the Imperial Service, and points out by contrast the energetic measures adopted by our government in Cuba. The British authorities, he says, "love to ponder things. They will go on pondering for twenty years."

L. O. Howard.

The World and the Individual. Gifford Lectures Delivered before the University of Aberdeen. Second Series: *Nature, Man and the Moral Order.* By Josiah Royce, Ph.D., LL.D. (Aberdeen), Professor of the History of Philosophy in Harvard University. New York, The Macmillan Co. 1901. 8vo. Pp. xvii + 480. Price, $2.25, net.

Although it contains what may be called a philosophy of nature, this new series of Gifford Lectures presents less of direct interest to readers of Science than its predecessor. Accordingly, as a detailed philosophical criticism would be out of place here, it may suffice to give a general account of the work, and some indication of the author's standpoint.

The lectures, ten in number, fall roughly into three main parts and an epilogue. (1) Lectures I.–III. furnish what Mr. Royce himself calls 'a sketch of an idealistic Theory of Human Knowledge' (Preface, vi). Lecture IV., on 'Physical and Social Reality,' mediates between this Theory and the outline of a Philosophy of Nature, which follows. (2) Lecture V. supplies this outline, and an inkling of its purport may be obtained from the following passage. "Any hypothesis about Nature, which is just to the demands of a sound metaphysic, must, like ours, conceive the natural world as directly bound up with the experiences of actually conscious beings. That, in addition to all these considerations, we should be led to reject Berkeley's cosmological hypothesis, is due, in part, to our own special form of Idealism; but, in part, also to the fact that our theory about nature ought to be just to the empirical inductions which have now been summed up in the modern Doctrine of Evolution. The essence of this Doctrine of Evolution lies in the fact that it recognizes the continuity of man's life with that of an extra-human realm whose existence is hinted to us by our experience of Nature. Accepting, as we are obliged to do, the objective significance of this modern doctrine, we find ourselves forced to interpret Nature, not as an arbitrarily determined realm of valid experiences founded only in God's creative will and man's sensory life, but as an orderly realm of genuine conscious life, one of whose products, expressions, and examples we find in the mind of man" (241–2). (3) Lectures VI.–IX. discuss the self and the problems which occur in considering the relation of the self to a universe of physical and social reality, where it is at once a factor and the feature. Lecture X. contains the epilogue. Here, gathering up all the conclusions reached hitherto, Mr. Royce attempts to estimate the significance of the individual life in relation to the cosmic whole, and to that ultimate unity which natural religion terms God. Of course such an inquiry touches the conclusions of modern science at every point. But, for this very reason, it is difficult in any case, and impossible in a short review, to show what the point of contact is. Rather, each one who is interested must find out for himself by perusal of the entire argument.

Apart altogether from its considerable weight as a contribution to original metaphysical thought, the work has great significance as an indication of prevalent philosophical tendencies in English-speaking lands. Save for the sporadic efforts of Coleridge and Carlyle in Britain, of Emerson and his group in this country, the English mind remained in long isolation from the transitive speculation of Europe, originated by Kant and Herder, cast abroad by Goethe, and systematized by Hegel. At length, in the sixties of the nineteenth century, thanks to Dr. Stirling, Wallace, the brothers Caird, Mr. W. T. Harris and the St. Louis circle, Hegel burst upon the Anglo-Saxon world, and threatened to carry all before him by the seventies. During the same years, the hypothesis of evolution, together with certain discoveries in physiology and physics, brought scientific men into contact with metaphysical problems which had been stilled awhile. Huxley's speculations, significant in their changes, Clifford's 'mind-stuff,' and similar so-called 'monistic' theories, were the result—a belated product being Haeckel's recent 'Riddle of the Universe.' While the immanent tendencies and animating problems happened to be much the same in both cases, it may be declared that the Hegelian and the Clifford-Huxley explanations could not be true together. As a matter of fact, each emphasized elements incident to the problem which the other minimized. A few of the younger men trained, like Mr. Royce, in the idealistic school, have come to clear consciousness of this situation; and, retaining the essential principle for which Hegel stands, have striven to rid themselves of his formalistic baggage, so affording opportunity for a fuller recognition of the scientific standpoint and—more important—of the scientific conscience. On the whole, then, these lectures are essentially mediating. This constitutes their strength now, and will prove their weakness twenty years hence. They cleave to the idealistic as opposed to the 'monistic' solution. On this ground I have no fault to find with them.

At the same time, I am by no means satisfied that the implications of 'monism' have been threshed out thoroughly, even if the discussion differ widely, as it does, from such cavalier treatment as that accorded, say, by Professor Pringle Pattison in the new 'Dictionary of Philosophy.' Moreover, I have very serious misgivings about the evident reversion to Fichte manifested by Mr. Royce. Nevertheless, his lectures constitute a thoroughly characteristic contribution—one that cannot be overlooked—to the very meaningful development within the English sub-Hegelian school. And if Mr. Royce appear to look back more than Mr. F. H. Bradley or Mr. Ellis McTaggart, one must perhaps hold the lecture-form of his work partly responsible. I am still haunted by the idea, to which I have given expression more than once, that it is a real misfortune that Mr. Royce should have produced so extended a series of books dominated by this method. For, as he himself says, 'In the public lecture-room the hearer has no time to meditate, and the speaker too little opportunity to be either concise or exhaustive.' We await the 'system' therefore. Like little girls, we believe in the man in the moon, but, like older girls, we would believe more in the man in the honeymoon.

R. M. Wenley.

University of Michigan.

SCIENTIFIC JOURNALS AND ARTICLES.

Popular Science Monthly for February is of more than usual interest for the general reader. The first article, on 'Stellar Evolution in the Light of Recent Research,' by George E. Hale, shows how much knowledge has been gained by the use of the camera and spectroscope. In 'Winged Reptiles' S. W. Williston tells of the pterodactyls, and particularly of the great American toothless species of the genus *Ornithostema,* which includes the largest flying animals. Appropriately following this is 'The Journeyings of Birds,' by F. H. Knowlton, which gives an excellent résumé of the subject of bird migration, and Otis T. Mason discusses 'Environment in Relation to Sex in Human Culture'; and R. H. Thurston, in 'The College Man as Leader in the World's Work,' expresses his belief that the educated man will in the future be even more in the front than now. Charles B. Dyke treats of 'Theology *versus* Thrift in the Black Belt,' believing that the religious teaching received by the average negro is apt to make him care little for the things of this world, and is thus a drawback to him, while Lindley M. Keasbey intimates, in 'The Descent of Man,' that his physical inferiority to beasts of prey acted as a stimulus to his brain.

The Osprey for January begins a new series in a new garb, with new type. It contains 'The California Jay,' by D. A. Cohen; 'Random and Reminiscent Maine Bird Notes,' by W. C. Kendall; 'August Birds of Stony Man Mountain, Virginia,' by William Palmer; and a review of the 'Life and Ornithological Labors of Sir John Richardson,' by Theodore Gill. A review of 'Animals of the Past' includes reproductions of the restorations of *Phorochacos, Archæopteryx* and *Hesperornis*. Also, in the form of a supplement we have the first part of a 'General History of Birds,' starting with an interesting history of the etymology of bird.

The Museums Journal of Great Britain, for January, under the title 'The Man as Museum-Curator,' has an appreciative notice of Dr. G. Brown Goode in a review by F. A. Bather of the memorial volume published by the Smithsonian Institution. There is also a good article, 'On the Arrangement of Mineralogical Collections,' by J. G. Goodchild, and notes on 'New Zealand Museums' and 'Oxford Museums,' besides a long list of General Notes, which as a rule constitute a most, if not *the* most, interesting portion of scientific periodicals.

SOCIETIES AND ACADEMIES.

THE CHICAGO SECTION OF THE AMERICAN MATHEMATICAL SOCIETY.

THE tenth regular meeting of the Section was held at Northwestern University, Evanston, Illinois, on January 2 and 3, 1902. Four sessions were devoted to the reading and discussion of the following papers:

(1) Professor M. W. HASKELL: 'A fundamental theorem in the geometry of the tetrahedron.'

(2) Professor M. W. HASKELL: 'A theorem for the twisted cubic analogous to Pascal's theorem.'

(3) Professor M. W. HASKELL: 'A special cubic transformation in space.'

(4) Professor H. S. WHITE: 'Note on a twisted curve connected with an involution of pairs of points in a plane.'

(5) Dr. J. W. GLOVER: 'On the derivation of the asymptotes of an algebraic curve from the definition' (preliminary communication).

(6) Professor ARNOLD EMCH: 'Algebraic transformations of a complex variable realized by linkages.'

(7) Professor L. W. DOWLING: 'On the conformal representation of the isosceles triangle containing an angle of 120 degrees.'

(8) Professor E. H. MOORE: 'On Hilbert's plane desarguesian geometry.'

(9) Dr. F. R. MOULTON: 'A simple non-desarguesian geometry.'

(10) Dr. JACOB WESTLUND: 'Note on multiplying perfect numbers.'

(11) Dr. JACOB WESTLUND: 'On the class number of a particular cyclotomic number-field.'

(12) Dr. CHARLES L. BOUTON: 'The equivalence of linear differential equations for a transformation of the independent variable.'

(13) Dr. T. P. HALL: 'An algebra of space.'

(14) Professor J. B. SHAW: 'Commutivity of matrices and application to the theory of linear associative algebra.'

(15) Dr. H. G. KEPPEL: 'A cubic three-way locus in four-fold space.'

(16) Dr. J. C. FIELDS: 'An equivalent of Plücker's formulæ.'

(17) Professor H. B. NEWSON: 'On the product of linear substitutions.'

(18) Professor G. A. MILLER: 'On the groups of order p^m which contain operators of order p^{m-2}.'

(19) Professor L. E. DICKSON: 'Some simplifications in the theory of linear groups.'

A topic of a more distinctly pedagogical character was introduced by Professor Townsend, namely, the question of uniformity in the requirements for the Master's degree where mathematics is the major subject, and the allied question of equivalent credits for students migrating from one institution to another. After some discussion the matter was referred to a committee for report at the next meeting of the Section. An enjoyable feature of the meeting was the dinner served in one of the University buildings to the members present, and followed by an exhibition by Dr. Keppel of about fifty portraits of eminent mathematicians.

At the business session the secretary was re-elected for the ensuing year and associated with him on the program committee were Professors Townsend and Dowling.

Thomas F. Holgate,
Secretary of the Section.

THE TORREY BOTANICAL CLUB.

At the annual meeting of the Club, held on January 14, the Secretary reported 15 meetings held with an attendance averaging 20; 28 active members elected, total present active membership 238. Alternate meetings have been held at the Botanical Garden at Bronx Park and at the College of Pharmacy. The number of scientific papers has been 26, besides about 34 informal notes.

The editor in chief, Professor Underwood, reported issue of the largest volume of the *Bulletin* in its history, 706 pages and 48 plates. It is the intention to make the *Bulletin* a necessity to botanists the world over. The monthly index of recent literature has been reprinted as usual in card form and includes 983 titles for 1901, an increase of 127. Volume 10 of the *Memoirs,* including the first part of E. S. Burgess' 'Aster Studies' is nearly through the press. No. 1 of Vol. 11, Mr. Griffiths' memoir on North American Sordariaceæ, has been printed. The principle adopted with the issue of Vol. 7 to make the memoirs pay for their own publication has been eminently successful. An increased sale of recent volumes and of sets was reported. The following forthcoming publications were announced: In Vol. 8, the conclusion of Professor Lloyd's studies on the embryology of the Rubiaceæ; by Dr. A. W. Evans, 'A Monograph of the Lejeuneæ of the United States and Canada'; by Mrs. E. G. Britton and Miss Alexandrina Taylor, 'The Life History of *Vittaria lineata;* in Vol. 11, 'The Ulothricaceæ and Chætophoraceæ of the United States,' by Mr. T. B. Hazen; Vol. 12, the second part of E. S. Burgess' 'Aster Studies.'

Dr. M. A. Howe, the editor, reported an encouraging first year for *Torreya,* the monthly started by the club with January, 1901, for briefer notes and botanical matter of a more popular nature.

Dr. J. K. Small reported on the recent installation of the club's herbarium at the Botanical Garden, where it is now to form the nucleus of a representative local collection to cover the flora of New York and vicinity within the 100-mile limit.

The annual election followed, the officers elected including Hon. Addison Brown, *President;* Dr. T. F. Allen and Dr. H. H. Rusby, *Vice-Presidents;* Professor F. E. Lloyd, *Treasurer;* Edward S. Burgess, *Recording Secretary;* Dr. L. M. Underwood, *Editor of the Bulletin;* Dr. M. A. Howe, *Editor of Torreya.*

E. S. Burgess,
Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

The 123d meeting was held January 22. The first paper, 'The Development of Septa in Paleozoic Corals,' by Dr. J. E. Duerden, gave an account of some of his recent results on the mesenterial and septal development of modern and fossil corals. After referring to the difference in this respect between *Porites* and *Madrepora* as compared with most other recent corals, the author proceeded to show how closely the septal development in the Palæozoic Rugose corals conforms with the mesenterial sequence in living Zoanthid polyps. Serial sections of the Carboniferous *Lophophyllum proliferum* (McChesney) demonstrate that the primary stage in the growth of this coral is six-rayed, and that in the subsequent development new septa are added successively within only four of the six primary interseptal chambers. The relationships can also be confirmed by means of the external ridges and grooves on the corallum.

The facts prove that while in their primary stage the Rugosa are hexameral, yet they can not be brought into close relationship with modern corals, but are undoubtedly allied to the Zoanthids which flourish to-day mainly in tropical seas. In the past the Zoanthids probably bore much the same relationship to the Rugose corals which living Actinians hold to recent corals.

The second paper, entitled 'The Mesabi Iron Range,' was presented by Mr. C. K. Leith.

Mr. Leith discussed certain new developments in the geology of the Mesabi iron range of Minnesota. He showed that the Keewatin series of the Minnesota Survey comprises two distinct series—an igneous 'basement complex' and a sedimentary series. The former is classed as Archean and the latter as Lower Huronian by the United States Geological Survey. The district therefore shows a complete succession from the Archean through the Lower Huronian into the Keewenawan, and in the fullness of the succession and in the clear-cut unconformities the Mesabi may be regarded as the type of Pre-Cambrian district of the Lake Superior region.

The iron ores result from the alteration of certain peculiar rocks composed of aggregates of minute green granules. The granules were called *glauconite* by Spurr, and were supposed to be of organic origin. The present investigation, however, shows them not to be glauconite. They are composed essentially of ferrous iron and silica, and lack potash, a constituent essential to glauconite. The granules, it is believed, were developed in much the same manner as the iron carbonates, which are the original iron-bearing rocks of the older iron districts. The iron (derived from the disintegration of older basic rocks) was carried in a ferrous form into the ocean, which was depositing iron formation material, and was there precipitated as hematite or limonite, and at the bottom of the ocean was again reduced by organic matter to a ferrous form, and then combined with silica, giving the substance we now find. The occurrence of the substance in granules is due to the same causes as the oolitic structure in limestone. After the iron formation, thus formed, emerged from the sea, weathering and the concentration of the ore began. The ferrous silicate was broken up and the iron oxidized. As the work was done through the agency of percolating underground waters, the position of the ore deposits was determined by the laws of flowage of such waters. The deposits are now found in gently pitching troughs formed by the gentle folding of the iron formations and bottomed by slaty layers, or their altered equivalents, the paint rock, in the iron formation.

Dr. Whitman Cross then made some comments on an article by Mr. Bailey Willis dealing with stratigraphic classification. Dr. Cross expressed the belief that a geologic map should express as much of geologic development as practicable; that a map whose cartographic units were discriminated solely on the lithologic characters of the so-called 'lithologic individuals' was not entitled to be called a geologic map. It was really a lithologic map. He contended that in order to express geologic development the units of cartography must be established with due regard to all classes of available facts, and that restrictions were both undesirable and unnecessary.

ALFRED H. BROOKS,
Secretary.

DISCUSSION AND CORRESPONDENCE.

THE ENDOWMENT OF RESEARCH.

TO THE EDITOR OF SCIENCE: In SCIENCE of February 8, 1901, N. S., Vol. XIII., p. 201, there is an article by Professor E. C. Pickering remarking on and requesting suggestions in regard to the reasons why there is so little demand for grants from various funds which are available for research. I had hoped that some one with wide experience would have some suggestions to offer on this subject. But since no one, so far as I am aware, has published a reply, I am moved to offer a few thoughts of my own. I feel inclined to do so at this time because Mr. Carnegie has just endowed research on a magnificent scale, and, as some of the difficulties which have confronted Professor Pickering will doubtless confront the trustees of this fund, a discussion of the matter seems particularly desirable.

The lack of requests for research funds is not because there is lack of desire to do research work. There are plenty of students eager to investigate questions in which they are interested. More than a dozen have mentioned such a desire to me within the last ten years. Two or three of these were Harvard or Technology graduates, amply prepared by training to carry on such researches. I have told all of them of the different research endowments with which I was acquainted and mentioned especially the two funds in which I know Professor Pickering is interested as a trustee. However, I think not one of these persons applied for an appropriation from these funds.

I have sought the reasons for this, and I believe the chief one is that each person feels that in case such funds are granted he will be expected to give in return some tangible result or discovery, and who can tell when entering an unknown country whether anything will be discovered worthy of the name? The student may be compared to De Soto entering a new country in search of gold. He may find nothing but seemingly interminable forests, passage through which is beset by pain and even danger, and he may return discouraged without the expected gold, his work being regarded by himself and by the friends who helped him as an absolute failure. And yet, as De Soto discovered a land the great forests of which returned more value in gold than the wildest dream of the explorer, and where fertile valleys now support a population whose total wealth must be counted by millions of dollars, so a student seemingly finding nothing may really have discovered facts which a succeeding generation will consider of inestimable value. Even negative results are frequently of great value in pointing out the true road to the subsequent explorer. In my opinion, then, research funds should be administered in the broad spirit that all results are valuable, and while the funds should made to feel that all that is required of him is be granted judiciously, the student should be an earnest effort in quest of truth and a guarantee that such an effort has been made.

The feeling that the trustees of these funds expect definite results has, I know, in my own case, except in one instance, deterred me from asking for grants. Many lines of investigation suggest themselves to me, and some of them I feel might be approved by the trustees, but I cannot be sure that the results will be what I had hoped or even worthy of publication; so I refrain from asking for grants, preferring to spend my own money, however inadequate, in order that I may be free to publish results when I have any worthy of publication, and refrain when I have none.

Another reason why students do not apply for research endowments is because they are usually granted in sums so small as to be entirely inadequate for the work. No one can estimate exactly, and usually not even approximately, how much money it will take to penetrate an unknown region or attain an unknown result. He may find that if he accepts a small amount it will prove only adequate to allow him to learn the difficulties of the situation, and yet insufficient to allow him to obtain any results whatever. A remedy would be to give larger and less numerous amounts, or assure the student of more if the preliminary study is promising.

A third reason why many students do not apply is that most of the grants stipulate that no money must be spent for personal expenses. If a student is not wealthy this requirement means that he must give his best thought and spend the main part of his energy in earning a living, a duty which he cannot shirk, and give to research only the remaining fragments of his time, and perhaps a weary brain. Few care to undertake it. This aspect of the case, from the teacher's standpoint, is given by Professor E. L. Nichols in the article in Science which immediately follows that of Professor Pickering (Vol. XIII., p. 203). He says, "The tax upon the nervous system of the proper teaching of science is very great, and it is more often the want of surplus energy with which to carry on an investigation, than lack of actual time or of the necessary equipment that defeats us."

If the student has wealth he does not need endowments and usually does not ask for them, but prefers instead to give them. If all men with equal opportunities were equally capable of research, as is frequently, but erroneously, assumed, this restriction of research funds would not matter since the work of research could be left to the classes having wealth and leisure, while the others could do the necessary daily work of the world. But the talents of men are diverse. The military genius of a Grant may be associated with an inability to acquire or even retain wealth. Inventions which have added enormously to the wealth of the nation have been made by men so poor that they were obliged to borrow money for living expenses. A prominent patent attorney with much experience recently said to me that he thought inventors as a class were without business ability, that is, without the ability to turn advantageously the product of their brains into money by means of which they could have leisure to do other work. No one can say how much the world has lost by the inability of the properly qualified men to give their best thought to discovery and invention. Had such a fund as that given for research by Mr. Carnegie been available in the past and been properly administered, the human race would in my opinion have been transformed into something immensely better than we have at present.

Hence, I believe that research funds, instead of prohibiting the payment of the personal expenses of the investigator, should be mainly devoted to the payment of such expenses, so that the investigator might be allowed to devote his whole time and his best thought to the investigation, even if for only a short time.

The funds thus administered would have plenty of applicants, and much work would be thrown on the trustees in seeing that the appropriations were made to the proper persons and properly used, but this is a task I think the trustees ought to assume.

H. H. CLAYTON.

HYDE PARK, MASS.,
Jan. 21, 1902.

A RARE 'WHALE SHARK.'

TO THE EDITOR OF SCIENCE: The National Museum has obtained a skin of a rare 'whale-shark,' *Rhinodon*, from an eighteen-foot specimen found on the beach three miles north of Ormond, Florida, January 25, 1902, this being the first record of the occurrence of the genus on the Atlantic coast of America. The Museum is indebted to Messrs. Anderson and Price, managers of the Hotel Ormond, who telegraphed the discovery to the Smithsonian Institution and later had the skin removed and shipped to Washington under instructions from Dr. F. W. True, Head Curator, Department of Biology.

Rhinodon typicus was first figured and described by Dr. Andrew Smith in his illustrations of the zoology of South Africa, in 1841, the type being a sixteen-foot example found at the Cape of Good Hope.* Another one of this species taken at the Seychelle Ids. is known from the teeth only.†

A genus related to *Rhinodon* was described by Dr. Theodore Gill in the proceedings of the Academy of Natural Sciences of Philadelphia, 1865, p. 177, under the name *Micristodus*, from jaws, vertebræ and notes, received by the Smithsonian Institution in 1858, from Captain Stone, and taken from a twenty-foot shark captured in the Gulf of California, where it was known as the '*Tiburon ballenas*,' or 'Whale Shark.'

BARTON A. BEAN.

U. S. NATIONAL MUSEUM,
WASHINGTON, D. C.,
Feb. 8, 1902.

RECENT PROGRESS IN GLACIOLOGY.

OUR knowledge concerning glaciers past and present is gradually being extended by local studies in various parts of the earth. For several years, systematic effort has been made to record observations on the movements of existing glaciers for the sake of determining the conditions and laws governing their advance and retreat. Harry Fielding Reid has published a number of articles bearing on this general topic in recent years. The last of these articles‡ presents a summary of existing knowledge on the present phases of glacier movement in various parts of the world, with reference to advance and retreat.

Most of the glaciers of the Swiss Alps are retreating. In the eastern Alps about one half are retreating, while about one fourth are stationary, and nearly as many advancing. In

* Preserved in the Museum of the Jardin des Plantes, Paris.

† British Museum.

‡ 'Variations of Glaciers,' *Journal of Geology*, Vol. IX., pp. 250–254.

other parts of the Alps retreat is the rule. The meager records from Scandinavia indicate general retreat for the glaciers which have been under observation. The few available records from the United States (including Alaska), Canada, Greenland and Russian Asia indicate the same phase of glacier movement. In the Himalayas there has been little change observed in recent years. More extensive observations, carried on through long periods of time, are much to be desired.

A significant conclusion has been reached by Myron L. Fuller* in his studies of the glacial drift of eastern Massachusetts. He finds evidence of two distinct sheets of till, the lower being differentiated from the upper, both physically and lithologically. The physical difference is such as to indicate that the underlying sheet of till was subjected to extensive decay before the overlying sheet was deposited. This conclusion is in harmony with the recent interpretations put upon the drift in other parts of the State by other geologists, and with the interpretations which have long been given to the drift of the Mississippi basin.

Glaciation has been determined† in Siberia between the parallels of 35° and 36°, and near the 93d meridian there is evidence of glaciation in an area about one hundred square miles in extent. Among the glacial features are drumlins and cirques. Elsewhere cirques occur in the high Altais, and glaciers are now found in the same mountains about the sources of the Irtish River, near the Mongolian border, at elevations of about 10,000 feet.

Several points of interest in connection with the Pleistocene glaciers in the western part of the United States have been determined during the past year.‡

Mr. Wallace W. Atwood has been studying the glacial drift of the Wasatch mountains, and has determined the positions of 50 Pleistocene glaciers exceeding a mile in length. Of these, ten exceeded five miles in length; fourteen descended to an altitude of less than 6,000 feet, and seven to an altitude of 5,000 feet. Seven of these glaciers reached the shore-line of Lake Bonneville. The elevation necessary to give rise to a glacier was about 9,000 feet. Mr. Atwood and his party also found that the drift of the Wasatch mountains is referable to two distinct epochs of glaciation. In the valley of the North Fork of the American Fork, the two sheets of drift, produced by glaciation from nearly opposite directions, are separated by a soil thicker than that which covers the surface of the upper sheet of drift. Other evidences of the duality of the glacial period in this region are found in the unequal weathering to which different parts of the drift have been subjected, and in the unequal amount of erosion which the drift of different localities has suffered.

Pleistocene glaciation has been determined in the mountains of New Mexico near Santa Fe. The glaciation, so far as determined, was between the parallels 35° 45′, and 36°, and between the meridians of 105° 35′ and 105° 50′. Within this area, the positions of something like 50 Pleistocene glaciers have been determined, chiefly by Messrs. John Webb and William A. Averill. Study was carried far enough to indicate that local glaciation was the rule, in the vicinity of altitudes reaching or exceeding 12,000 feet. Some of the glaciers reached a length of several miles. The glacial features found in this region are such as are developed by small mountain glaciers.

Pleistocene glaciers were found to have existed on the north slopes of the Spanish Peaks of Colorado. The glaciers here were less extensive than might have been anticipated from the elevation of the mountains, but their small size is probably the result of the small extent of the areas attaining the requisite height.

In northwestern Montana, east of the Rocky mountains, Mr. F. H. H. Calhoun has studied the relations of the drift deposited by the Keewatin ice sheet to that deposited by the glaciers coming out to the eastward from the mountains. It appears from his work that the Wisconsin drift extended somewhat farther to the westward than has been supposed, reach-

* 'Probable Representatives of Pre-Wisconsin Till in Southeastern Massachusetts,' *Jour. of Geol.*, Vol. IX., pp. 311–329, 1901.

† 'A Single Occurrence of Glaciation in Siberia,' *Am. Geol.*, Vol. XXVII., pp. 45–47, 1901.

‡ 'Glacial Work in the Western Mountains in 1901,' by Rollin D. Salisbury. *Jour. of Geol.*, Vol. IV., pp. 718–731.

ing nearly to the Rockies in the region mentioned. The drift of the northeastern ice sheet overlapped that coming from the mountains, just south of the 49th parallel. This relation of the two bodies of drift shows that the continental ice sheet reached its most advanced position after the valley glaciers from the west had retreated. There is no evidence, however, that the interval between the deposition of the two bodies of drift was considerable. The Sweet Grass Hills, just south of the 49th parallel, and thirty miles back from the edge of the ice sheet, were nunataks. The slope of the surface of the continental ice sheet between its edge and the Sweet Grass Hills is estimated to have been about 50 feet per mile. A long narrow lake existed in front of the Keewatin ice sheet, the standing water resulting from the obstruction of drainage by the ice. The present drainage of the region is in many respects notably different from that which obtained in pre-glacial times.

Messrs. George Garrey and Eliot Blackwelder, partly in company with the writer and partly alone, made a number of determinations with reference to Pleistocene glaciation west of the Rockies and east of the Cascades. The boundaries of the Okanogan or Coulee City (Wash.) ice lobe, south and east of the Columbia River, were traced out. This ice lobe had previously been made known by Russell, and its general limits indicated. Messrs. Garrey and Blackwelder also determined the existence of a great glacier down the valley of the Columbia just west of the 118th meridian. This glacier descended the valley of the Columbia to the point where the Spokane River comes in. The eastern margin of this glacier looped northward around Huckleberry Mountain (Tp. 32, R. 38 E.), and to the east of this point another glacier descended the valley of the Colville River. These two glaciers were, therefore, separated only at their southern ends, becoming continuous to the north. The eastern margin of the Colville glacier, which descended to Springdale, probably connects around Old Dominion Mountain with the ice which descended the Pend d'Oreille valley. The ice of this valley descended southward to a point three miles southwest of Davis Lake. A few data were also gathered concerning glaciation at points farther east.

Extensive deposits of loess were found in eastern Washington and northeastern Oregon. In geographic distribution, the loess corresponds, in a general way, with the wheat-growing areas of these States. Beds of volcanic ash are sometimes interbedded with the loess. Some of the loess, how much was not determined, had an æolian origin.

ROLLIN D. SALISBURY.

RECENT ZOOPALEONTOLOGY.

A FOSSIL CAMEL FROM SOUTHERN RUSSIA.

PROFESSOR NEHRING,* of Berlin, describes the skull of a Pleistocene camel from beds along the Volga, in the same state of preservation as the mammoth, wild horse, reindeer and *Elasmotherium*. From the distribution of this and other Pleistocene camels in Roumania and Algiers, the author agrees with the view expressed by Lehmann (1891) that the dromedary and Bactrian camel originated in two distinct regions, the former being a *subtropical* steppe and desert animal, the latter belonging to the *subarctic* steppes and deserts.

FOSSIL REMAINS OF LAKE CALLABONA.

E. C. STIRLING,† director of the South Australian Museum, opens a series of memoirs on the large deposit of fossil bones discovered in the bed of Lake Callabona, South Australia, first reported in *Nature* in 1894. The present memoir is devoted to the manus and pes of *Diprotodon*, the largest and most abundant marsupial in this remarkable deposit. The salt clay in which the bones were embedded was always wet, the necessary excavations soon filling with water. Nevertheless fourteen feet were removed *en masse* within large balls of the matrix clay. Besides the great difficulties of removal the fossils had to be carried two hundred miles to a railway station, by camel

* 'Ein fossiles Kamel aus Südrufsland, nebst Bemerkungen über die Heimat der Kamele,' *Sonderabdr. aus dem Globus*, Bd. LXXX., Nr. 12, pp. 188–189.

† 'Fossil Remains of Lake Callabona,' Part I. *Mem. Roy. Soc. S. Australia*, Vol. I., Part I., pp. 1–40, Pl. I.–XVIII., 4to. Adelaide, 1899.

transport. The limbs evidently rested chiefly on the carpals and tarsals, the phalanges and metapodials being extraordinarily reduced with the exception of the metatarsal of the fifth digit. The feet as a whole are comparable to those of the wombats, there being evidences of syndactylism and reduction in the second and third digits. A limb of *Genyornis,* the great struthious bird from this deposit, has recently been sent to the American Museum.

TRANSFERENCE OF SECONDARY SEXUAL CHARACTERS FROM MALES TO FEMALES.

In this brief but important paper, Dr. C. I. Forsyth-Major* reviews Darwin's statement in the 'Descent of Man,' as to the probability that horns of all kinds, and canine tusks even when they are equally developed in the two sexes, were *primarily* acquired by the male in order to conquer other males and have been transferred more or less completely to the female. Darwin's inference did not rest upon paleontological evidence, and Dr. Major therefore reviews the evolution of the families of Cervidæ, Giraffidæ, Bovidæ and Suidæ, with the general conclusion that Darwin's inference was correct. He concludes with the remark, "In our own species the modern aspirations of women are to all appearances incipient signs of the same natural law. Physical and mental characters of man, originally acquired in the struggles of the males, are apparently being slowly transferred to women. They only require time for their full evolution."

HOMO NEANDERTHALENSIS A DISTINCT SPECIES.

Professor G. Schwalbe† publishes in the proceedings of the *Anatomische Gesellschaft* an exhaustive study of the famous Neanderthal skull, which he concludes as follows:‡ "I believe I have shown that the Neanderthal skull is distinguished by no small number of characters which in many respects bring it much nearer that of the anthropoid apes than that of man. I therefore regard the position of King and of Cope in designating this as a type of a distinct species as entirely justified. I follow in this respect the modern practice of zoologists and paleontologists. This species is by no means to be included with the Paleolithic or Quaternary man; it is an older form, which is to be compared only with the skull of Spy, and the lower jaw found at Naulette. Very probably these skulls belong to the lowest diluvium, lying near the limits of the Tertiary, although the possibility must be admitted that *H. Neanderthalensis* may represent a persistent lower race contemporary with the newer Pleistocene *Homo sapiens.*"

* *Geol. Mag.*, Dec. IV., Vol. VIII., 1901, pp. 241–245.

† 'Ueber die specifischen Merkmale des Neanderthalschädels,' *Verh. der Anat. Ges.*, XV. versamml. in Bonn., 26–29 Mai, 1901, pp. 44–61, 8vo. Jena.

‡ Translation and abstract.

DISTINCTIONS BETWEEN THE SKULLS OF LEMURS AND MONKEYS.

Dr. C. I. Forsyth-Major,* of the British Museum, has recently been comparing in a most exhaustive and critical manner the facial region of the lemurs and monkeys, and has especially shown that the commonly accepted view of the exposure of the lachrymal bone upon the face as a primitive character is probably erroneous. This has been one of the most frequently employed distinctions between lemurs and monkeys. He proves that, on the contrary, even in the supposedly ancestral Insectivora an exposed lachrymal and lachrymal canal are not a common character. In the fossil lemurs, *Adapis* shows the lachrymal bone and duct within the orbit. Among existing types the lachrymal is scarcely more frequent in the lemurs than in the higher groups, and the greatest known reduction of this bone occurs within the lemurs. The author's conclusion is that a great facial expansion of the lachrymal, and particularly its extension beyond the fossa lachrymalis is, in the lemurs, as well as in the monkeys, not a primitive condition, but an extreme specialization; it can always be traced back to an elongation of the facial cranium necessitated by a more powerful dentition. In the reviewer's opinions each elongation is not secondary but primitive.

* 'On some Characters of the Skull in the Lemurs and Monkeys,' *Proc. Zool. Soc.*, Feb. 19, 1901, pp. 129–153, Pl. XI.–XIII.

DISTINCT PHYLA OF RHINOCEROSES.

IN 1900 Osborn attempted to demonstrate that the rhinoceroses, so far from being included in a single genus, should be separated into at least six lines of descent, which have been distinct for so long a period that they are almost entitled to subfamily value, extending back to the Lower Miocene and even probably into the Oligocene. Oldfield Thomas and R. Lydekker, of the British Museum, have recently accepted this conclusion in the main, and the former* proposes to divide the living types into three genera, namely, *Rhinoceros*, the Indian forms *(R. unicornis, R. sondaicus)*, *Dicerorhinus* Gloger, the two-horned Sumatran types (Thomas points out that this name has the priority over *Ceratorhinus* Gray), and *Diceros* Gray for the African two-horned species (this name taking precedence over *Atelodus* Pomel). It is pointed out that Osborn was in error in describing the smaller African rhinoceros *(D. bicornis)* as dolichocephalic since its head is much shorter than that of *D. simus*, the white rhinoceros. Professor A. Nehring, of Berlin, also dwells in a recent paper upon the extraordinary dolichocephaly of the white rhinoceros, showing that the skull surpasses in length even the longest recorded skull of the woolly rhinoceros (*D. tichorhinus*).

H. F. O.

* 'Notes on the Type Specimen of *Rhinoceros lasiotis* Scalter; with Remarks on the Generic Position of the Living Species of Rhinoceros.' *Proc. Zool. Soc.*, June 4, 1901, pp. 154–158.

THE BOTANICAL SECTION OF THE CONCILIUM BIBLIOGRAPHICUM IN ZÜRICH.

FOR some years past the increasing success of the Concilium Bibliographicum in the zoological part of its work induced a number of botanists to urge this institute to undertake a botanical bibliography on similar lines to those followed in zoology. Such a course was also recommended by the chief of the Swiss 'Department of Interior' in awarding the government subsidy to the work. Such wishes have always found a sympathetic echo with the committee in charge of the Concilium, as well as with the founder of the Institution. It seemed, however, unwise to extend the enterprise to other branches, until the finances had become quite satisfactory. For this reason, no public statement of our intention in this regard has been made, save such general allusions as are to be found, for example, in the presidential address to the Botanical Section of the American Association meeting in 1900.

Recently, however, the committee of the new 'Association Internationale des Botanistes' has offered us means for organizing such a section of the Concilium without involving the latter in financial liabilities greater than it could with safety assume. The negotiations which were begun by telegraph late in January have been carried on with great rapidity, and we are now able to announce the organization of a botanical section comprising two energetic Zürich botanists, Dr. Stephan Bruneis and Mr. Emil Schoch-Etzensperger. For the year 1902 it is of course out of the question to issue a card catalogue. The year will be spent in preparation, so that the difficulties encountered in the first two years of the zoological card bibliography may be entirely avoided. Also no attempt will yet be made to record new species and genera, as is done in zoology. For the present merely the well-known bibliography of the *Centralblatt* will be continued, with certain minor improvements. The main object of this announcement is to make a direct personal appeal to all those who publish botanical papers, urging them to send copies to the *Concilium Bibliographicum, Zürich-Neumünster, Switzerland.* It is particularly important that this appeal should be brought home to editors and publishers of periodicals containing botanical notices; for the journals are far easier to excerpt than authors' reprints. Journals already reaching a Zürich library need not be sent; but we hope that all botanists will assure themselves of this fact before assuming that their collaboration in the matter of securing a given publication is unnecessary. The response that zoologists in America have given to our former appeals justifies the hope that their botanical brethren will show similar public spirit.

HERBERT HAVILAND FIELD.

ZÜRICH.

SCIENTIFIC NOTES AND NEWS.

The twenty-fifth anniversary of the founding of the Johns Hopkins University and the inauguration of Dr. Remsen as president of the university were celebrated at Baltimore on February 21 and 22. The commemorative address of Dr. D. C. Gilman, for twenty-five years president of the university, and now president emeritus and president of the Carnegie Institution, and the inaugural address of President Remsen are published above, as is also the list of those on whom honorary degrees were conferred. The assembly of eminent educators, scientific men and others at the exercises was one of the most notable that has gathered in America. One of the most interesting events was the presentation to Dr. Gilman of an address signed by over 1,000 alumni and others who are or have been connected with the university.

The University of Pennsylvania has conferred the Doctorate of Laws on Professor Wolcott Gibbs.

At the annual general meeting of the Royal Astronomical Society on February 14, the Society's gold medal was presented to Professor J. C. Kapteyn, of Gröningen, Holland, for his work in connection with the Cape Photographic Durchmusterung, and his researches on stellar distribution and parallax. The Jackson-Gwilt (bronze) medal and gift was presented to the Rev. Thomas D. Anderson, of Edinburgh, for his discovery of Nova Aurigæ and Nova Persei.

Dr. T. J. J. See, U. S. Naval Observatory, has been elected to membership in the Deutsche Mathematiker-Vereinigung, and to the Société Mathématique de France.

Dr. Ernst von Bergmann, professor of surgery at Berlin, was given the title of privy councillor on the Emperor's birthday.

Professor Max Gruber, of the University of Vienna, gave the Harben Lectures before the Royal Institute of Public Health in January, the subject being 'Bacteriolysis and Hemolysis.'

Mr. William Marconi sailed for Canada on February 22 to continue his trans-atlantic experiments in wireless telegraphy.

Mr. C. E. Borchgrevink, the antarctic explorer, is at present lecturing in the United States.

Professor Duclaux, director of the Pasteur Institute, Paris, suffered recently an attack of hemiplegia. After lying in a critical condition for a number of days, he is now improving.

The papers note that a marble statue of Professor Ernst Haeckel is being made by the sculptor Harro Magnussen.

Mr. John Ackhurst, a taxidermist residing in Brooklyn, died on February 15 at the age of eighty-six years.

Dr. E. Selenka, professor of zoology at Munich, died on January 20, at the age of sixty years.

There will be a civil service examination on April 2 for the positions of plant pathologist, chemist, physiological chemist and analytical chemist in the Philippine service. The salaries of these positions are from $1,500 to $2,000. There will also be filled by civil service examination on the same day the position of agrostological clerk in the Bureau of Plant Industry at a salary of $720.

Mrs. George Whitfield Collett has contributed $5,000 to the endowment fund of the New York Botanical Garden, in memory of the late Josiah M. Fiske.

The laboratory for the investigation of cancer in Buffalo has been removed into the building donated through the generosity of Mrs. Gratwick.

Professor B. Tirusch has bequeathed to the Museum of Natural History at Prague his library and estate, valued at $25,000. He had previously given numerous specimens to the zoological, botanical and geological sections of the Museum.

Mr. Deboe, of Kentucky, has introduced a bill in the Senate to establish a university of the United States. It provides that the grounds set aside by Washington for a university, lately occupied by the U. S. Naval Observatory, are to used as the site.

THE Minnesota Seaside Station party of 1902 plans to leave Minneapolis on July 12, at the close of the meeting of the National Educational Association. It will proceed via the Canadian Pacific Railway to Vancouver, thence by steamer to Victoria and finally to Port Renfrew by coasting vessel. The party will return to Minneapolis about September 1, giving a month or more by the sea and ample time for stops in the Rockies and Selkirks, arrangements for which have been made with the railway. The following staff is expected to organize the work of instruction and, as far as necessary, research, during the term of station activity: Professor Conway MacMillan, M.A., director-in-chief and lecturer on algology (Phæophyceæ); Professor Raymond Osburn, M.S., professor of zoology; Professor K. Yendo (Rigakushi), professor of algology (Rhodophyceæ); Miss Josephine E. Tilden, M.S., professor of algology (Chlorophyceæ and Cyanophyceæ).

THE annual report of Will. C. Ferrill, curator, State Historical and Natural History Society, Denver, Colorado, shows the following record for the past year. The additions to the library and historical collections were 1,159, and to the scientific collections, 3,425 specimens, making a total for the year of 4,584. This Society, which is both historical and scientific in its scope, now occupies fourteen rooms in the state house, and its museum was visited during the past year by 156,148 people. A valuable addition to the museum during the year was the Horace G. Smith Arapahoe County collection of about 650 birds, obtained in the vicinity of Denver. These, together with Colorado specimens obtained by Curator Ferril in field work, added to an older collection, now give the department of ornithology about 2,500 specimens of Colorado birds.

IT should have been stated in the issue of SCIENCE for February 14, page 269, that the original journals of Lewis and Clark will be published under the auspices of the American Philosophical Society.

A WRITER in the New York *Sun* states that the strange giant cactus, *Cereus giganteus,* is being exterminated by irrigation, and that many years will not elapse before extinction has taken place. This is probably an extreme view of the case, for there must be many localities, comprising vast areas of land, where irrigation will not only not be attempted, but be impossible, and here the weird-looking plant may hold its own. The species attains a height of sixty feet and, contrary to popular belief, is short lived. Moisture is fatal to it and as soon as it receives a constant supply rapid decay sets in and destroys the plant.

AFTER being cut off from communication with the outside world for two and a half years in hitherto unexplored parts of mid-Asia, Dr. Sven Hedin, the Swedish explorer, reached India towards the close of December. In an outline of his expedition the London *Times* says that reaching Andijan by the Transcaspian Railway in the middle of 1899, he traveled to Kashgar on horseback, and from thence sailed down the river Tarim, or Yarkunddarja, to Lob Nor, in the heart of Eastern, or Chinese, Turkestan. Making this place on the shores of the lake of the same name his headquarters, he took excursions of varying length through the Gobi Desert and over the great range of the Shian Shan mountains. Out of the 6,000 miles thus traveled only some 500 miles were along the tracks of earlier wanderers, all the rest having been unexplored. He discovered a series of ruined cities of Chinese and Mongolian origin, about 800 years old, and found in them some extraordinary sculptures and some ancient manuscripts of an extremely rare description. These cities would, he said, throw an altogether new light on questions affecting the distribution of the various human races and the migratory movements of Asiatic peoples. He went through the whole of the northern and central parts and a portion of Eastern Tibet, and through the great Gobi Desert in Western China. His last and most prolonged journey was right across Tibet, first from north to south and then from south to west. He proposed to publish three 'rather ponderous tomes of a scientific nature,' but he would first compile a large book for popular reading giving a description of his travels. He had taken over 4,000 photographs and numerous sketches. In scientific results this was far and away the most important journey he had ever made, and he expressed his gratitude to King Oscar, and to some friends interested in scientific research for placing the means at his disposal for the journey.

The Geographical Journal states that it has lately been announced that an expedition, under the command of Lieutenant Héron, and including several other officers on its staff, was to leave Marseilles for Indo-China on January 12. Its object is to complete our knowledge of the coasts of Indo-China by accurate surveys, and to study the distribution of terrestrial magnetism in that region, besides carrying out general investigations in matters relating to hydrography and navigation. It sails under the orders of the Minister of Marine.

UNIVERSITY AND EDUCATIONAL NEWS.

The gift of Mr. John D. Rockefeller to the Harvard Medical School of $1,000,000 was conditional on $765,000 being collected to meet the sum required for the removal and rebuilding of the school. Of this sum about $600,000 has been subscribed in two weeks.

The executors of the will of the late Jonas D. Clark have agreed to transfer $800,000 to Clark University for the establishment of a collegiate department.

Buchtel College at Akron, Ohio, has received an unconditional gift of $20,000.

The directors of the Pennsylvania Railroad have given $5,000 to the fund for the rebuilding of the University of Wooster, destroyed by fire on December 11.

A bill is now before the New York Legislature, appropriating $200,000 for new buildings for the College of Agriculture at Cornell University.

The State Department has notified President Butler, of Columbia University, of the receipt of a despatch from Minister Conger at Pekin, which gives full information regarding the gift of books and other material to illustrate the instruction in Chinese subjects to be undertaken under the new Dean Lung or Charpentier foundation at the University. The collection selected by the Foreign Office of China for presentation to Columbia is known as the T'u Shu Chi Ch'eng, a standard collection of ancient and modern works. It is the most comprehensive ever made in China and consists of more than 6,000 volumes, divided into thirty-two classes in which all facts regarding China are recorded and classified, all sources of information and all authorities cited and discussed.

It is announced that hereafter students of the medical school of Yale University may complete the course in three years if they elect the necessary preliminary studies in the academic department.

Dr. Chas. H. Judd, professor of psychology in the University of Cincinnati, has received a call to Yale University.

Dr. J. W. Moore, professor of physics, has been appointed dean of the Pardee Scientific Department of Lafayette College, succeeding the late Dr. T. C. Porter.

Dr. W. F. Snow has been made acting-head of the department of hygiene at Stanford University.

Mr. S. E. Brasefield has been appointed instructor in civil engineering in Lafayette College.

The Universities of St. Petersburg, Kieff and Kharkoff have been closed, owing to the difficulties between the students and the authorities.

The Government has dismissed all the European professors at the Imperial University of Pekin, and Dr. Martin, the president, has been offered a subordinate position.

Mr. F. T. Tronton, M.A., F.R.S., has been appointed to the Quain chair of physics in University College, London.

Mr. Frederick Purser, fellow of the College, has been elected to the chair of natural philosophy in Trinity College, Dublin, lately vacated by Dr. Tarleton.

Mr. George Reynolds, M.A., F.R.S., professor of engineering in the Owens College, Manchester, has been appointed to the office of Rede Lecturer at Cambridge University for the present year.

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, MARCH 7, 1902.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

AMERICAN SOCIETY OF BACTERIOLOGISTS.

THE third annual meeting of the Society was held at Chicago University on December 31, 1901, and January 1, 1902. The President of the Society was Professor W. H. Welch, of Johns Hopkins University. The following are abstracts of the papers presented at the three sessions of the Society:

Conditions affecting the Thermal Death-point of Bacteria in Milk: H. L. RUSSELL and E. G. HASTINGS, State University, Madison, Wis.

The authors have tested the resistance of bacteria in the surface pellicle ('scalded layer') that forms on milk when it is heated to temperatures of 60°C. and above. They confirmed under commercial conditions the fact demonstrated by Theobald Smith under laboratory conditions that the resistance of the tubercle organism is materially increased when milk is heated in contact with the air. In order to demonstrate this increased resistance more clearly they further experimented with a peculiarly resistant coccus that they had found in milk, which had, in a vegetative stage, a thermal death-point of 75°C. when exposed for ten minutes in sealed tubes. In open tubes the organism retained its vitality as high as 82°C. When surface membranes were removed and plated on agar, colonies developed from them, but not from samples of the milk below. The increased resistance is not due to lowered temperature at surface, as was shown by removing membrane and placing same in water, when it sunk to the bottom. The protection therefore afforded the bacteria is due to the nature of the membrane itself, preventing the heat from exercising the usual effect.

The Comparative Growth of Bacteria in Milk: H. W. CONN, Wesleyan University, Middletown, Ct.

This paper described a series of experiments, the design of which was to determine what species of bacteria develop in milk during the first twenty-four hours and what species disappear. The general purpose of the experiments was to determine as far as possible the relation of milk bacteria to the healthfulness of milk. The conclusions presented by the paper were as follows: (1) Milk freshly drawn from the cow contains a large variety of bacteria. (2) For the first six hours and sometimes more, there is no increase in the number of bacteria, even when the milk is kept at 70°. On the contrary, there is commonly a decrease due to what has been called the 'germicide power' of milk. (3) In the fresh milk the largest number of bacteria are streptococci, which come, in most cases, directly from the udder of the cow. (4) During the first forty-eight hours there is a very great increase in the number of bacteria, but the number present after one or two days' growth is quite independent of the number present at the start. In many cases milk, which when fresh contained a small number of bacteria, at the end of forty-eight hours contained a number far greater than other samples of milk which at the outset had a larger number of bacteria present. (5) During the first forty-eight hours there is a considerable increase in the number of streptococci, followed by their decrease and final disappearance. (6) At the outset the number of lactic bacteria is extremely small, so small as, at times, quite to escape observation. (7) These lactic bacteria are, at least in the series of experiments described, derived from sources external to the cow and never, or rarely, from the milk ducts. (8) The lactic bacteria, though very few in number at the outset, increase far more rapidly than any other types, so that within twenty-four hours they are commonly in the majority, and by the end of forty-eight hours they commonly comprise considerably over ninety per cent. of all the bacteria present.

Rusty Spot in Cheddar Cheese: H. A. HARDING and L. A. ROGERS, N. Y. Agricultural Experiment Station, Geneva, N. Y.

Rusty spot is a bacterial trouble of cheddar cheese characterized by reddish-yellow discolorations scattered in points or blotches throughout the mass. The cheese does not become poisonous and the flavor is not affected, but the market price is reduced on account of the unusual appearance. This trouble is confined to a few factories, but a considerable part of their output is affected. A short, plump, causal bacillus was isolated by Cornell in 1898 and called *Bacillus rudensis*. By the addition of pure cultures to vats of milk he was able to reproduce the discoloration in the resulting cheese. In practice, the main source of trouble is the bacterial growth upon the factory utensils. However, there are often outside foci in connection with the dairies, capable of reseeding the factory after it has been once freed from the infection by a careful cleaning and disinfection. The direct application of steam to all the factory utensils on three days each week was tried in three infected factories during the past season. This is most easily accomplished by placing all the small utensils in the large vat, drawing a canvas cover over the same and forcing steam into the vat for twenty minutes. This treatment was highly successful in two factories and fairly so in a third where the outside influences were quite unfavorable.

On the Apparent Identity of the Cultural Reactions of B. coli communis and Certain Lactic Bacteria: S. C. PRESCOTT, Massachusetts Institute of Technology, Boston, Mass.

While engaged in an examination of certain lactic bacteria, the author was impressed with the similarity presented by some of the cultures to *B. coli communis,* and has carried on investigations with a large number of lactic-acid-producing organisms, comparing their cultural reactions to those of *B. coli.* He defines the colon bacillus as a short, motile rod of intestinal origin, which forms thin, irregular films upon the surface of gelatin; produces no liquefaction; gives nail growth in stick cultures; a whitish translucent layer upon agar; a more or less abundant, moist, yellowish growth upon potatoes; produces turbidity and some sediment in broth; ferments dextrose and lactose with the formation of gas; reduces nitrates to nitrites; coagulates milk; reduces litmus with subsequent slow return of the color, and produces indol.

The lactic acid group is broadly defined as consisting of those bacteria in which the ability to bring about the fermentation of sugars to lactic acid is strongly developed. Forty-seven cultures were isolated from the following sources: bran (7), fresh meat (3), sour milk (4), flour (2), cornmeal (6), buckwheat (7), barley (4), butter culture (3), an acid-producing organism in technical use (5), and a breakfast food (2). All these were tested in the following particulars: growth on litmus, lactose agar, gelatin agar, milk, dextrose broth, nitrate solution, Dunham's solution, bouillon and potato; and were further compared morphologically with relation to motility and spore formation, and with relation to air. Of the forty-seven cultures examined, twenty-five gave the typical colon reactions; six gave the tests weakly or failed in one test only, while the others failed in a greater degree. Some of the bacteria from most of the sources gave typical colon reactions.

The author points out two views that may be entertained regarding these bacilli: (1) They may be true colon bacilli from sources which can only be conjectured, or (2) they may be lactic acid organisms, not absolutely identical with the colon bacilli, but yet almost impossible to differentiate from them. The latter view the author regarded as more probable. Of great importance is the fact that had they been isolated from water they would have been undoubtedly regarded as colon bacilli. Hence the work has a very practical sanitary bearing and indicates that too much reliance must not be placed upon the so-called colon test of potable waters.

Oysters and Sewage in Narragansett Bay: CALEB A. FULLER, Brown University, Providence, R. I.

The city of Providence discharges, daily, about 14,000,000 gallons of sewage into upper Narragansett Bay, chiefly through a single main. This sewage is carried down the bay by tide and comes into more or less direct contact with some of the oyster beds. Samples of water and oysters were collected from different localities in the bay, and analyses made before the material was six hours old. The ordinary tests for sewage contaminations were used, the fermentation tube, carbol broth and litmus lactose agar.

The results showed: (1) That water,

oysters, mussels and clams from a point one quarter of a mile distant from the sewer opening contained *B. coli, B. cloacæ* and *Bact. lactis aërogenes.* (2) That water and oysters from a bed two miles below the sewer contained the same organisms. (3) That thirty per cent. of the oysters and about sixty per cent. of the water samples from a bed situated in a strong tidal current, about five miles from the sewer, contained *B. coli.* (4) That forty per cent. of the oysters and seventy per cent. of the water samples from a bed in sluggish water, five and a quarter miles from the sewer, contained *B. coli.* (5) That oysters from a bed six miles below the sewer contained *B. coli.* (7) That oysters from a bed six miles and one half below the sewer contained no colon bacilli; the water contained *B. coli* only occasionally and then on a falling tide. (7) That beds still farther down the bay were entirely free from contamination.

Toxicity of Water toward Pathogenic Bacteria and the Possible Significance of the same in the Spontaneous Purification of Polluted Waters: H. L. Russell, Madison, Wis.

The preliminary data here reported have to do with the action of natural water on the vitality of various bacteria, particularly pathogenic organisms. When typhoid and colon organisms (several cultures of each) were inoculated in boiled waters (surface, deep well, spring) growth generally occurred. This was more marked with the colon than with the typhoid, and was more pronounced where the seeding was light. When the same cultures were exposed to the action of water filtered through a Chamberland or Berkefeld filter, or to etherized waters in which the anæsthetic had been removed by aspiration, growth not only did not take place, but the numerical content was greatly reduced, so that the cultures were often sterile in twenty-four hours. Further test showed that this toxicity of filtered water was lost when heated to about 60°C. for ten minutes. The origin of these toxic substances is ascribed to the development of water bacteria, as shown by taking boiled lake water and seeding the same with water bacteria. After incubation for thirty-three days, this water was again filtered and found toxic for typhoid and colon, which toxicity was again lost by reheating. Some bacterial species develop luxuriantly in standing water and, in some of the cases, it was found that these grew quite rapidly in filtered water, indicating their ability to tolerate the toxins. The relation of this toxicity to the destruction of pathogenic and fæcal organisms in water was suggested.

The Bacteria of the Ames Sewage-disposal Plant: L. H. Pammel, Agricultural College, Ames, Iowa.

The Ames sewage disposal plant has been in operation since 1898. During this time bacteriological, chemical and temperature records have been kept; account also has been taken of the flow of raw sewage and the effluent. These records indicate that this form of sewage disposal is a most efficient one, and is adapted for many inland towns. The average number of bacteria per c.c. in the effluent from January to December, 1899, inclusive, was 5,127. For the year 1900 the record is somewhat incomplete, arising from an unavoidable loss by fire; but from January, 1900, to September, 1900, inclusive, it was 5,414, having been as efficient as the previous season, the smallest number having been found during August, when there were 546. In January the average was 830; in September, 850. The average number of bacteria in the manhole, from August, 1899 to September, 1900, inclusive, was 639,720.

The average number of bacteria in tank during the same period was 446,611. The records during 1901 are as follows: Average number of bacteria per c.c. in effluent, 14,785; average number of bacteria per c.c. in manhole, 1,318,328; the average number of bacteria per c.c. in tank, 1,667,522.

No effort has been made to study a large number of different forms found in the effluent. *B. cloacæ, B. coli communis, B. liquefaciens fluorescens* and *Sarcina aurantica* have been found. *Bacillus prodigiosus* has also been found. This was introduced from the Manhattan sewage in 1900. That season it was found three times in the tank on June 19, in the east effluent on June 22, and in the west effluent on June 27. It was not found again till August, 1901, when it appeared in the effluent and continued to appear until the first of September. Various media were used. The Nütterstoff Heyden did not prove better than either pepton agar-agar or pepton gelatin. The blue litmus-agar and gelatin are excellent for differentiation.

On the Germicidal Action of the Organic Peroxides: DRS. F. G. NOVY and P. C. FREER, University of Michigan, Ann Arbor, Mich.

The investigation of the authors was begun with the object in view of finding the correct explanation of the action of metals and of sunlight upon bacteria. As is well known, certain metals, such as gold and copper, exert a marked inhibiting and even germicidal effect upon some bacteria. The studies of Miller, Behring and Bolton, Thiele and Wolf, have fully established the above-mentioned fact, but the interpretation of the results has not been wholly satisfactory. The fact that various surfaces, such as metals and fabrics, exert a marked effect upon the formation of benzoyl acetyl peroxide was established by the authors and served as a basis for the view that metals act upon bacteria by giving rise to energetic peroxides, which, of necessity, must be more active than ordinary peroxides. The action of sunlight has been ascribed by different workers to hydrogen peroxide, but the destructive action observed is greater than that which can be credited to this body. In order to substantiate the theory of the authors regarding the action of metals and of sunlight, it was deemed necessary to investigate the action of a number of known organic peroxides. The results show that some of these bodies, such as aceton peroxide and dibenzoyl peroxide, are wholly inert.

On the other hand, solutions of diacetyl, benzoyl acetyl, and of benzoyl hydrogen peroxides, and of phthalmonoperacid, exert pronounced and even remarkable germicidal properties. With reference to diacetyl peroxides and benzoyl acetyl peroxide, it was shown that the bodies themselves are chemically and bacterially inert, but on contact with water they undergo hydrolysis and give rise to the extremely energetic acetyl hydrogen and benzoyl hydrogen peroxides.

A solution of these peroxides (1: 3,000) is capable of destroying all pathogenic bacteria, and even such resisting spores as those of the potato bacillus, within one minute. Cholera and typhoid germs added to tap water are promptly destroyed by the addition of one part of peroxide to 100,000 parts of water. The authors point out the probable value of these peroxides in the prevention and cure of these and allied diseases. The destruction of bacteria in the mouth and saliva takes place with extraordinary rapidity and the reagents have shown themselves useful in diseases of the mouth.

The powerful effects of the organic peroxides is not explainable as due to nascent oxygen, since a solution of hydrogen peroxide, which will produce equal germicidal action, contains one or even two hundred times as much nascent oxygen. The authors incline to the belief that the acetyl and benzoyl ions are the active agents.

Full papers upon this subject will appear in the *Journal of Experimental Medicine* and in the *American Journal of Chemistry.*

The Etiology of Yellow Fever: Walter Reed, M.D., Surgeon U. S. Army, and James Carroll, M.D., Contract Surgeon, U. S. Army.

In former contributions to this subject the authors have shown by observations made on human beings that yellow fever may be produced in the non-immune individual either by the bite of the mosquito (genus *Stegomyia*) or by the subcutaneous injection of a small quantity of blood (0.5 to 2 c.c.) drawn from the general circulation of a patient suffering with this disease. Thus far, however, microscopic examination of the blood, as well as of the bodies of infected mosquitoes, has proved negative. Cultures taken from the blood during the active stages of the disease also have yielded equally negative results. Leaving out of consideration, therefore, for the present the further microscopical search for the specific agent, both in the blood of the sick and in the bodies of infected mosquitoes, the authors presented some additional observations bearing on the etiology of the disease. In conducting these experiments they have been guided by the observations of Loeffler and Frosch on the foot and mouth disease of cattle, wherein it was conclusively demonstrated that the specific agent of this disease was so small as to readily pass through the pores of a porcelain filter.

Adopting the same line of procedure, it was ascertained that in yellow fever the blood serum which has been filtered through a Berkefeld laboratory filter is still capable of producing this disease when subcutaneously injected in small quantity (1.5 c.c.) into non-immune human beings. The authors reported an attack of yellow fever after the usual period of incubation in two out of three individuals thus treated, and further stated that the blood drawn from one of the cases produced by the injection of the filtered serum was capable of producing an attack in a third individual, when injected in small quantity; thus proving that the specific agent had really passed through the filter. They were also able to show that the blood in yellow fever, when heated to a temperature of 55°C. for ten minutes is quite innocuous if injected into susceptible individuals. The specific agent of yellow fever therefore is destroyed or markedly attenuated by this degree of heat.

Brain Abscess in Typhoid Fever due to Bacillus typhosus: R. W. McClintock, Rush Medical College, Chicago, Ill.

There are mentioned in the literature up to August, 1901, nineteen cases of meningitis and five of abscess of the brain in connection with typhoid fever, *Bacillus typhosus* having been present in all the cases of meningitis, but not found in any case of abscess of the brain.

Clinical History.—Temp. 101° A.M. to 104° P.M. In second week, rose spots appearing on 8th day, nausea on taking food; diazo-reaction questionable. Third week, agglutination test probably positive. Fifth week, 33d day, three epileptiform convulsions at intervals of forty minutes, followed by clonic spasms lasting five minutes, very much more marked on the right side than on the left; pupils equal. Much mental confusion in following two weeks, with marked amnesic aphasia. During eighth week, much better. In ninth week spasms returned, with coma, terminating in death on the 66th day.

Autopsy.—Suppurative basilar meningitis; abscess of left temporal lobe; purulent exudate in lateral ventricles; healing typhoid ulcers in ileum; acute splenic tumor; cloudy swelling of solid viscera; moderate diffuse arteriosclerosis; chronic interstitial nephritis.

Histology.—The organs show the usual typhoid appearances. The wall of the brain abscess shows a capsule, with purulent exudate inside, and regenerative changes outside; and with groups of short blunt bacilli with rounded ends, both inside and outside the capsule.

Bacteriology.—The cerebellar exudate and the cerebral abscess both contain in pure cultures an actively motile bacillus of typhoid-like morphology, which from its growth on differential culture media and from its reactions with typhoid serum, and the action of its specific serum on typhoid and allied bacilli, is evidently *Bacillus typhosus.* The same organism, together with *Bacillus coli communis,* is also present, in the liver and kidney; the lung contains *Staphylococcus pyogenes citreus;* the blood from the heart and the kidney is sterile.

The Diplococcus scarlatinæ: W. J. CLASS, M.D., Chicago, Ill.

The author gives a brief description of a germ which he considers the etiologic factor of scarlet fever. This germ is a polymorphic coccus, usually occurring as a large diplococcus. It stains with any of the ordinary aniline stains, has no capsule and no independent motion. It forms small grayish-white colonies upon a special medium devised by the author, consisting of glycerine agar to which five per cent. of garden earth has been added. It also grows to some extent upon blood serum and in bouillon. It is found in the throat secretions, blood scales and urine of patients suffering from scarlet fever. It is also found in certain cases of angina which are probably scarlatina *sine* eruption. Control experiments have been made showing that the germ is found practically only in cases where contact with scarlet fever patients can be traced. Swine, guinea-pigs and mice are susceptible to the diplococcus. In swine a disease characterized by fever, a red rash and subsequent scaling has been produced by Gradwohl Jaques and the author. Organs from these animals examined histologically by Le Count showed the changes usually found in fatal cases of scarlatina. Experiments were made regarding immunity. These showed that blood from a scarlet fever patient conferred immunity against the *Diplococcus scarlatinæ.* Guinea-pigs were also immunized by means of blood serum from a pig that had been injected with gradually increased doses of the toxin. The author gave the following reasons why he considers this diplococcus to be the causative factor of scarlet fever. (1) Because the germ is invariably present in cases of scarlatina. (2) Because it is a decidedly pathogenic microorganism. (3) Because with it a disease can be reproduced in swine which closely resembles scarlet fever. (4) Because blood serum from a scarlet fever convalescent exerts an inhibitory effect upon the germ, whether in the body or in culture. (5) Because the germ grows in milk without producing any change in the medium. (6) Because the disease produced in mice and swine is contagious. (7) Because the authors' findings have been corroborated by reliable observers so often that errors of observation can be excluded. In closing, the author makes a plea that the germ be given a thorough investigation, as he feels certain that unprejudiced work will show the truth of his statements.

A Contribution to the Physiological Differentiation of Pneumococcus and Strepto-

coccus, and to Methods of Staining Capsules: P. H. HISS, M.D., College of Physicians and Surgeons, New York.

The author believes that up to the present time it has not been demonstrated that pneumococci and streptococci can at all times be clearly differentiated from each other. Well-marked capsules have been found by various observers to occur on organisms more reasonably classified as streptococci than as pneumococci. On the other hand, capsules may not be demonstrable by the usual methods on pneumococci, especially when these organisms are growing on artificial media. Pneumococcus cultures may also show a predominance of chains, while streptococci may occur in pairs. The usual cultural characters and reactions of these organisms are at the best not diagnostic, and are subject to variations.

Experiments by the author, with cultures of pneumococci and streptococci from many different sources indicate well-marked, constant differences between the metabolic activities of pneumococci and those of streptococci. These differences in metabolism become apparent when the organisms are cultivated in the following media: (1) A medium composed of ox serum, one part; distilled water, two parts; normal sodium hydroxid, 0.1 per cent. (2) A medium composed of ox serum, one part; distilled water, two parts, and inulin, 1 per cent. These serum media are not coagulated by boiling and are sterilized at 100° C. Acid is formed in each of these media by pneumococci when grown at 37° C., and a solid yellowish-white coagulum results. The coagulation is rapid in the inulin medium, slower in the alkaline. Streptococci do not form acid in these media, and no coagulation occurs. These media have, therefore, in all instances, served to differentiate pneumococci from streptococci.

Other mono-, di- and poly-saccharids were tested in media made in the same manner as the inulin medium, but were fermented and the media coagulated, by various members of the streptococcus group, as well as by pneumococci. Hence, these carbohydrates are not of use in differential tests. Special methods were devised for demonstrating capsules on pneumococci and streptococci. Chief among these was to grow the organisms on ascitic serum agar, preferably plus one per cent. glucose. Spread the organisms on the cover-glass by mixing with a drop of serum, or a drop of one of the fluid serum media. Dry in the air and fix by heat. Then stain for a few seconds in a one half saturated aqueous solution of gentian violet. Wash off with a 0.25 per cent. solution of potassium carbonate, mount and study in this solution. This is a good stain for capsules of pneumococci in blood or serum of infected animals. Pneumococcus capsules may also be stained by the following method and be mounted in balsam without injury. A five per cent. or ten per cent. solution of gentian violet or fuchsin (500 sat. alcoholic sol. gentian violet plus 95 c.c. distilled water) is used. This is placed on the dried and fixed cover-glass preparation and gently heated until steam arises. The dye is washed off with a twenty per cent. solution of copper sulphate ($CuSO_4$ cryst.). The preparation is then dried and mounted in balsam. By these methods most streptococci were found to have capsules.

Well-marked examples of encapsulated organisms, such probably as those which have been described by some investigators, and separated by them into new species distinct from *Streptococcus pyogenes*, or with no certainty differentiated from pneumococci, have been examined and have been found to correspond to *Streptococcus pyogenes* in the media mentioned in this paper.

The conclusion from these facts is that such encapsulated organisms should with hesitation be separated from *Streptococcus pyogenes*, unless well-marked cultural differences can be shown to exist.

Branching in Bacteria, with Special Reference to B. diphtheriæ: HIBBERT W. HILL, M.D., Boston Board of Health Bacteriological Laboratory.

The chief problems considered divide themselves into morphological and physiological or developmental problems. The general subject is one of fundamental importance, theoretical and, in its relation to diagnostic work, practical.

The principal hypotheses to be considered as offered to explain branching may be briefly stated: (1) Accidental opposition. (2) Budding from single-celled rods. (3) The turning aside of a medial cell in a chain of closely connected cells, supposed to compose the larger bacterial rods, and the subsequent 'chaining out' of such a cell (Nakanischi's view). (4) The development of a medial melochromatic granule of a new rod. (5) Involuntary changes.

The writer describes the results of the examination of individual bacilli developing in a moist warm chamber under the microscope and concludes: (1) That degenerative (involutionary) changes do at times give rise to distortions distantly simulating branches. (2 and 3) That active branching, by apparent budding resulting in multiplication, does occur in young (five to ten hours old) cultures on agar. (4) That various modifications of the process exist. (5) That such branching may be reversionary or evolutionary in character, but involutionary only in the case noted above (1).

A review of the literature and consideration of nomenclature follow, and a number of drawings are given in the full article.

'Hanging Block' Preparation for Microscopic Observation of Developing Bacteria: HIBBERT W. HILL, M.D., Boston Board of Health Bacteriological Laboratory.

The writer cuts a cube of nutrient agar from a Petri dish full of solidified jelly. The organism to be examined, as an emulsion in water from a solid culture, or as a drop of broth from a liquid culture, is spread upon the upper surface of the agar, as in making an ordinary smear preparation on glass. After drying the cube at 37°C. for ten minutes, a clean cover-slip is applied to the inoculated surface and sealed in place by running a little melted agar round the edges of this surface. The cover-slip is then placed over the opening in the moist chamber, the agar block lowermost, and the microscope focused upon the bacteria. For organisms growing best at 37°C. some form of warm chamber is necessary. The writer describes two such warm stages, devised by himself, and a very simple method of securing a circulation of warm water through them.

A System of Recording Cultures of Bacteria Genealogically for Laboratory Purposes: BURT RANSOM RICKARDS, S.B., Boston Board of Health Bacteriological Laboratory.

The writer applies to the recording of all individual tube cultures of bacteria and the data relating to them a modification of the Dewey Decimal System under card catalogue entries to correspond. Each species is known by some whole number in the hundreds (or thousands if a great many cultures of one species are to be dealt with). Thus:

B. coli=100,	*B. diphtheriæ*=300,
B. typhi=200,	*B. mallei*=400.

Individual specimens of any one species are numbered in the order of their isolation, 1 to 49 (or 1 to 499 if the species are numbered in the thousands). Thus:

B. mallei from one horse=401,

B. mallei from a second horse=402,

B. mallei from a different lesion in the second horse=403.

The first culture isolated pure is given a number in the first place of decimals—thus the pure culture of glanders bacilli from the first horse mentioned would be 401.1.

Subcultures are expressed by the number of the original culture with the figure 1 placed in the next right place of decimals. If further subcultures (sister cultures) are made from the same mother culture, they are differentiated by increasing this last new figure in arithmetical order. The system is very simple, very accurate, very elastic, and, construed under the card catalogues described, saves an enormous amount of work, and ensures a complete record of every tube used.

Variety of the Hog Cholera Bacillus which closely resembles Bacillus typhosus: M. Dorset, Biochemic Laboratory, Washington, D. C. (By title.)

The author described a variety of the hog cholera bacillus which was isolated from a virulent outbreak of hog cholera in Page County, Iowa. This variety corresponds in every way with the hog cholera bacillus as usually seen, except in its action upon glucose, which it ferments without the evolution of gas. The failure to produce a gaseous fermentation of glucose places this variety of the hog cholera bacillus culturally closer to *Bacillus typhosus* than to the hog cholera group of bacteria. A comparison with several cultures of *Bacillus typhosus* has shown that culturally this variety of hog cholera bacillus cannot be distinguished from some of them; but the author concludes that when the source and pathogenic properties of this variety are considered, it should be classed among the hog cholera bacteria.

The Morphology of Bacillus Diphtheriæ: Frederic P. Gorham, Brown University, Providence, R. I.

The experiments described were made for the purpose of proving that the long, granular form of the diphtheriæ bacillus, type C of Westbrook, can be changed into the short, thick, solid-staining, sometimes double-headed bacillus, type D^2 of Westbrook. A pure culture of type C was made from a clinical case of diphtheria. After several platings a culture was obtained that showed only long granular forms, careful search and the use of Neisser's stain failing to demonstrate a single bacillus of any other type. Plates were made from this culture and some thirteen colonies examined. The colony that showed the largest number of shorter forms was selected, and plates made from it. This process of selection and plating was continued for some fifteen generations.

The colony of the fourth generation was composed of forms distinctly smaller than those of the original culture; all were still granular, however, and stained by Neisser's method. In the fifth generation, some of the bacilli failed to show granules by Neisser's method, were barred, and of the type C of Westbrook's. In the eighth generation many of the bacilli failed to react to Neisser's stain, and a large number of barred and solid staining forms were present. Some of these approached the double-headed type D^2. On continuing the selection until the fifteenth generation all the granular forms were eliminated and the colony became a pure culture of the type D^2; the majority of forms were of the double-headed variety.

The experiment is being continued by testing the various types for virulence. From the results already obtained it appears that the different forms of the *Bacillus diphtheriæ* can be produced by the variations of a single type.

An objection to the validity of these results, of course, can be made by the claim that pure cultures of the various types were not used. The objection seems to me not well taken, on account of the large number of platings and the fact that several generations were passed before any change appeared. These experiments are directly in line with the results already obtained by the author in the study of the changes of form observed in the diphtheria bacillus in the noses and throats of persons immune or becoming so.

A Note on Branched Forms of Tubercle Bacilli Found in Cultures: M. DORSET, Biochemic Laboratory, Washington, D. C.

The author describes branched tubercle bacilli found in a six weeks' old bouillon culture of human tuberculosis which had become contaminated with a streptothrix. The branches were always Y-shaped and, from various stages in the branching found in cover preparations, the author concludes that the branching has probably taken place in the following manner: The end of a rod first enlarges and then probably separates into two small knobs, which forms have been seen in the cover preparations. These separate knobs grow out and constitute the branches.

An Undescribed Pathogenic Diplococcus: H. GIDEON WELLS, Chicago University.

This was obtained first in cultures from a subcutaneous abscess on the thigh of a woman, aged twenty-two, with the following history: When sixteen years of age her hand was badly cut by a piece of window glass. The wound became infected and it was nearly a year before it entirely healed. During this time she developed a number of subcutaneous abscesses on other parts of the body, which healed slowly. During the six years that have followed she has had, at varying intervals, seldom more than three months, recurrences of the subcutaneous abscesses, which have appeared at one time and another, over almost the entire body. They appear independent of any injury or other known exciting cause, and produce only slight constitutional symptoms. The patient is in fair health otherwise, and is able to work except when an abscess is developing. Physical examination gives no information. Blood count shows 3,862,000 red and 7,100 white corpuscles two hours after dinner. Cultures from a vein gave the *Diplococcus* in pure culture at a time when the patient was free from abscesses. Inoculated into animals, the *Diplococcus* sometimes fails to cause any change. Sometimes it produces a slow emaciation which does not terminate fatally, but more often it causes local abscesses. The most characteristic fact is that it can be obtained from the heart's blood of these animals long after subcutaneous or intraperitoneal inoculation, even when there have been no local lesions, and when the animal seems well. It often produces abscesses at the sites of injuries several weeks or months after inoculation; in one case, after four months.

Morphologically, it resembles the *Gonococcus* in fresh cultures, sometimes later, becoming more a double sphere. It seldom forms chains or tetrades, does not destain by Gram's method, possesses a capsule that is difficult of demonstration in culture, grows well on all ordinary media, liquefies gelatin after three or four days at 24°C., with production of a funnel-shaped excavation filled with fluid. It produces no gas nor indol; slowly acidifies milk; produces no pigment; its growth is slimy and rather tenacious both in solid and liquid media.

The Distribution of B. coli communis in Natural Waters: C. E. A. Winslow, Massachusetts Institute of Technology, Boston, Mass.

The work of certain observers has shown that organisms apparently identical with *B. coli communis* are found widely distributed in nature. The problem for the bacteriologists, and especially for the sanitarian, becomes, then, a quantitative one. Even if this organism does occur in various places in the outside world, may it not still be true that it thrives only, or at least most abundantly, in the intestine of the higher vertebrates, and that an overwhelming proportion of the individual representatives of the species occurs in that habitat? May it not be true then that while the *Bacillus coli* is found at times in unpolluted waters, its presence, constantly, or in numbers, is still characteristic of sewage pollution? As a preliminary contribution to this question a number of presumably unpolluted waters in the neighborhood of Boston have been examined for the *Bacillus coli.* In each case one centimeter of the water was incubated in dextrose broth and one hundred cubic centimeters were incubated with the addition of phenol-glucose broth. From the one hundred cubic centimeter bottles, after incubation, dextrose broth was inoculated, and from all dextrose tubes showing gas, litmus-lactose-agar plates were made. Three characteristic colonies were fished from each reddened litmus-lactose-agar plate, and subcultures inoculated. Only those which gave the following reactions were considered as *B. coli:* The fermentation of dextrose broth with the production of gas in twenty-four hours; the fermentation of lactose in the litmus-lactose-agar plate, with distinct reddening in twenty-four hours; the coagulation of milk in twenty-four hours; the production of nitrite from nitrates in twenty-four hours; the production of indol in peptone solution in three days; the formation of an abundant growth covering nearly the whole surface of the agar streak in twenty-four hours, later becoming whitish and cheesy, but not stringy to the needle; the formation of round or oval white colonies in the gelatin shake culture, often with gas bubbles, with no liquefaction of the gelatin in seven days. The use of one hundred cubic centimeters appears in these experiments to have increased the proportion of dextrose and lactose fermenting organisms, but not of colon bacilli. The investigation included the study of seventy-nine samples of water. The results lead to the conclusion that the colon bacillus is so rare in normal unpolluted waters as to be found infrequently when single centimeters of the water are examined. The presence of this organism, constantly, or in a majority of cases, in one cubic centimeter, may still be assumed to be due to the entrance of some polluting substance.

Preliminary Observations on B. coli communis from Certain Species of Animals: Veranus A. Moore and Floyd R. Wright, Cornell University, Ithaca, N.Y.

A study has been made of *B. coli communis* found in a single place in each of the large and small intestines of nine horses, eleven cattle, eight sheep, four swine, eight dogs and six chickens. This organism was not found in the intestines of six frogs, two young and one old rabbit. It had previously been found in several rabbits. These animals were all supposedly healthy and, excepting the frogs and rabbits, were for the greater part killed for dissection or food. Cultures in bouillon from six colonies from the gelatin plate cultures from each of the large and small intestines were made; these were replated, and from the colonies which developed on them subcultures were made and studied on gelatin, agar and potato; in milk, bouillon, and in bouillon containing one per cent. dextrose, lactose and saccharose. The degree of motility and the indol reaction were also considered.

The purpose of these examinations was to find the extent to which varieties of this bacillus exist normally in the intestines of both different individuals of the same species and of different species of animals. This was to determine if the many varieties of the colon bacillus which have been described from polluted water, soil and from lesions of various kinds in man and animals, have their natural existence in the generally supposed normal habitat of this species of bacteria. The results showed no pronounced variation in the morphology or the cultural characters of these bacilli from different sources on gelatin, agar, potato and bouillon. The action on the sugars, milk and the indol production differed somewhat. The two varieties, A and B, described by Smith in 1896 were found. The A variety, *i. e.*, those that ferment, with gas production, dextrose, lactose and saccharose, and the B variety, *i. e.*, those that do not ferment saccharose, were found in about equal numbers in each species of animals. Other varieties did not appear, although there were slight variations in the quantity of gas, the gas formula, and the time required for the milk to coagulate. The cultures from different colonies from the same plates did not show any appreciable difference except in one instance, from a dog. The plate cultures made from one dog did not develop colonies resembling those of *B. coli communis*. The cultures from dogs were more virulent for guinea-pigs than those from the other species of animals. The action on the sugars was considered of the most differential importance.

Color Standards for Recording the Results of the Nitrite and Indol Tests: C. E. A. Winslow, Massachusetts Institute of Technology, Boston, Mass.

In studying the effect of certain external conditions on the reactions of the *Bacillus coli communis,* need was felt of some definite standard by which to measure somewhat quantitatively the capacity for nitrite and indol production. It is true that even when the conditions of the experiment—the composition of the medium, the amount and character of the culture used for inoculation, and the time allowed for the development of the reaction—are rigidly controlled, striking variations sometimes appear. The laws of such variations can, however, only be properly studied when their sequence is made manifest by definite comparable standards.

The use of a color standard for measuring the reduction of nitrate and the formation of indol obviously suggests itself as simpler and more practical than any other method. Up to the point at which a precipitate forms in the nitrite reaction, the depth of color in both cases may be considered as roughly proportional to the amount of the end product formed by the bacteria in a given time. The problem for the bacteriologist is then to select from the numerous schemes of color values, prepared for artistic and educational purposes, that one best suited for the matching of the reaction in question.

The most rational system of color standards is that prepared by Milton Bradley, of Springfield, Mass., based on pure spectral colors of known wave-length. It is issued in the form of a small booklet, and by cutting out and pasting to a card the colors between red and yellow, orange and their tints, a chart is obtained on which the color of the indol reaction produced by *B. coli communis* can be readily matched. The hue is read by holding the tube parallel to a white surface and looking through it at right angles, while the matching color on the card is isolated by a small card with a window cut in it. The tube and card are viewed in strong diffuse daylight. The Milton Bradley color scheme has not, however, proved satisfactory for measuring the reduction of nitrates. A large majority of the tubes tested lay somewhere between the reds and the violet reds of the scale, and could not be well matched with either. Some other standards were therefore sought and more suitable ones found in the book of standard colors published by Louis Prang, Boston, Mass. This system has no definite scientific basis. The hues are less pure and the tints less bright and clear than in the Bradley system; the gradations, however, are more numerous. Of the seven plates in the Prang book the last five, including the darker shades, are not needed. On the 'pure color' plate and the 'first shade' plate the colors produced by both the indol and the nitrate test can be quickly and easily matched. As far as this standard has been used it has been found to be a satisfactory system of record and an important aid in forming definite ideas as to the behavior of microorganisms under various conditions.

Observations upon the Morphological Variation of Certain Pathogenic Bacteria: A. P. Ohlmacher, M.D., Northwestern University Medical School, Chicago, Ill.

Three observations are here recorded. The first was upon experimentally-induced morphological variation in *B. diphtheriæ*. Here a race, presenting the long, granular or barred type, was transformed to the short, solid type by a forty-eight-hour sojourn in the subcutaneous tissue of a white rat. Two originally short, solid organisms were converted into long, granular ones by a single passage through the organs of a guinea-pig. In the second observation a race of *Streptococcus pyogenes* from a case of follicular tonsillitis was observed to assume the form of a large polymorphous bacillus each of the seven times it was transferred to Loeffler's medium, each time resuming the morphology of the ordinary *S. pyogenes longus* when grown in bouillon. A race of *B. coli communis* recovered from a case of gangrenous cholecystitis and cholangitis is concerned in the third observation, in which the organism showed a remarkable polymorphism in the original smears and early generations of cultures, taking on a diversity of forms from long, quite coarse filaments to excessively minute coccoid or diplococcoid organisms.

Special Laboratory Apparatus: Wm. R. Copeland, Spring Garden Water Works, Philadelphia, Pa.

The bacteriological laboratory at the Testing Station of the Bureau for Improvement, Extension and Filtration of the Water Supply in Philadelphia, has been equipped with the special object of making examinations of water. Therefore a thermostat was designed and built under special directions. The interior chamber is divided by perforated partitions into four sections. The glass doors, which hang directly in front of these sections, are divided in such a way that the door in front of one section may be opened without exposing the interior of the other sections to the temperature of the laboratory. Between the walls of the interior chamber and the surrounding jacket, strips of copper are soldered, so that water pumped into the open space between the walls must circulate round all four sides of the interior, before it can escape through the drain.

The apparatus employed at the Testing Station for filling test-tubes consists of a copper funnel screwed on to a brass pipe, which, in turn, is screwed on to the top of a brass cylinder. Inside of the cylinder is a brass plug containing two holes, one holding ten, and the other five, cubic centimeters. The plug fits snugly inside of the cylinder, but may be turned from right to left easily by a lever attached to a post on top of the plug. This post passes through a hole in the cap. A delivery tube is screwed on to the bottom of the cylinder, and is attached at a point 90° from the opening in the top cap to the funnel. Directly over the delivery tube a little hole is drilled through the cap to serve as an air vent.

When one of the chambers in the plug has been filled with the medium, the lever is reversed and, as the chamber passes over the delivery tube, the medium is discharged into a test-tube below.

An Unusual Bacterial Grouping: MARY HEFFERAN, University of Chicago, Chicago, Ill.

An organism presenting peculiar morphological characteristics, obtained from Kral's Laboratory Collection, Prague, was sent under the name of *B. rosaceus metalloides.* This organism produces an orange-red pigment, but differs from the original description of the above-named form in three important cultural features, viz., lack of metallic luster, for which *B. rosaceus metalloides* is peculiarly known, non-liquefaction of gelatin to any active degree, and possession of the power of motion. A hanging drop preparation from a bouillon culture of seventy-two hours, room temperature, shows the characteristic grouping to best advantage. Short small bacilli, about the size of *B. acidi lactici,* are seen grouped together in aster-like clusters varying in composition from but three or four bacilli up to fairly compact spherical burrs of rodlets radiating from a center. The number of these asters increases in a culture for several days, especially at the surface, where they are loosely packed to form a reddish surface scum. There seems to be nothing like a capsule or a gelatinous zooglœa massing. Below the surface a greater number of free motile bacilli are present. In old cultures the asters are irregular and fewer in number, free bacilli predominating. On solid media the aster formation has been observed only on agar cultures. The bacilli are longer and more slender than in bouillon, and, when stained, show the *Volvox*-like grouping very beautifully. On potato the bacilli are short and thick, and may show well-defined capsules enclosing two rods.

Observations on the important question as to whether the asters are formed by cell division as a process of growth, or by a method akin to agglutination, are as yet incomplete. The regularity of the formation, the occurrence on solid as well as in liquid media, and the final disappearance of the asters, point, however, to the conclusion that this phenomenon is a growth phase in the life-history of the organism.

An Improved Method of making Collodion Sacks: C. S. GORSLINE, M.D., University of Michigan, Ann Arbor, Mich.

Apparatus.—A long test-tube or other tube, closed at one end except for a perforation 2–4 mm. in diameter, and having a caliber corresponding to the diameter of the desired sack; a wide-mouthed 6–8 oz. bottle one-third full of colorless collodion of U. S. P. strength, and a few ounces of distilled water.

Manipulation.—Touch the perforated end of the tube to the surface of the collodion, thereby obtaining a film of collodion over the opening, but none inside. Allow this to dry a few moments. Incline the bottle containing the collodion as much as possible without spilling, and insert the tube, rotating slowly, allowing only the lower one-fourth to be immersed in the collodion. Withdraw from time to time to allow partial drying to take place, repeating the operation until the desired thickness is reached. As soon as the collodion has set, the tube may be repeatedly immersed in water at about 25° C. to hasten the drying of the sack. When this is accomplished pour distilled water into the open end of the tube, and applying the mouth, force the water, which carries the collodion ahead of it, through the perforation in the tube. The water now creeps in between the sack and the tube and this process is aided and made to progress evenly on all sides by slightly twisting back and forth on the free end of the sack. When the water has traversed the entire length of the sack, the latter slips off easily into the hand. The water, by its pressure, not only releases the sack, but tests it for weak places or perforations at the same time. Tubes may be made from one sixteenth inch to two inches in diameter and twenty inches long. 200 c.c. of saturated magnesium sulphate were dialyzed out through such a sack against running water in four hours and twenty minutes. Parchment requires seven to eight days to accomplish the same.

Neutral Red in the Examination of Water: ERNEST E. IRONS, University of Chicago.

In 1898 Rothberger found that *B. coli communis* will reduce neutral red in a culture medium, changing the color from red to a canary yellow, with an accompanying green fluorescence. Schleffler tested a number of races of *B. coli* and found that all gave the neutral red reaction. In 1901 Savage employed neutral red for the detection of *B. coli communis* in water. He concluded that a positive reaction, obtained with neutral red, while not certainly diagnostic of *B. coli*, yet in the vast majority of cases, points to the presence of that organism, and that in the case of the fifty waters examined, the margin of error in assuming that *B. coli* was present where a positive neutral red reaction was obtained, was less than five per cent.

The object of the present experiments was to determine further the value of neutral red in the routine examination of water. Following the suggestion of Savage, ordinary bouillon was used, to which was added one-half per cent. of dextrose and one per cent. of a one-half per cent. aqueous solution of neutral red. All cultures were kept at 37° C. Determinations were made by the dextrose fermentation tube and neutral red methods in exact parallel. Samples of forty-five waters were employed with a number of dilutions of each, such that in the case of each water *B. coli* was almost always found in the lowest, and rarely in the highest dilution. In this series 285 determinations were made by either method, with thirty-five per cent. positive results for the fermentation tubes and forty-seven per cent. positive with neutral red. Of the neutral red tubes showing positive results when the corresponding fermentation tubes were negative, 31 were examined for *B. coli*. From five of the 31 typical *B. coli* were isolated, and from 25 organisms were isolated which differed more or less from *B. coli*, but which gave the neutral red reaction. Of these 25, 18 gave no gas in dextrose bouillon. In all, 122 cultures were examined. Of 17 conforming culturally to *B. coli*, 15 gave a positive and two only a very slight reaction with neutral red. Of eleven gas-producing organisms, differing slightly from *B. coli*, four gave positive and seven negative reactions. Four organisms conforming culturally to *B. cloacæ* gave complete reactions. Of 65 non-gas-producers three gave decided, and 24 partial, reactions with neutral red.

The results show that the neutral red reaction is produced, under the conditions of the test, by a number of water bacteria, which no classification, however liberal, would place in the colon group.

A Graphical Tabulation of the Morphological, Cultural and Biochemical Characters of Certain Bacteria, together with References to Authorities, Synonyms, Literature, Etc.: ARTHUR I. KENDALL, S.B., Massachusetts Institute of Technology, Boston, Mass.

Great difficulty is experienced by bacteriologists in establishing the identity of a given bacterium whose morphological, cultural and biochemical characters have been worked out. This is due, as has already been shown, to the following facts: (*a*) Inaccessibility of the literature, (*b*) incompleteness of descriptions and indefiniteness of terms used, and (*c*) lack of uniformity, in both the choice and composition of media. The object of this paper is to collect in one set of tables the descriptions of as many bacteria as possible, tabulated after each individual characteristic, has been verified by comparison with the leading authorities, using (*a*) terms that admit of one and only one interpretation, and (*b*) terms that will exclude as far as possible the *personal factor*. The graphical method of tabulation first proposed by Fischer ('Vorlesungen über Bakterien'), and first used as a means of classification by Fuller and Johnson (*Journal of the American Health Association,* Vol. XXV., p. 580 et seq.), has been adopted because the definiteness of characteristics attained with this method of representation cannot be equalled by any other known method. Tables were shown, including those micrococci, which do not liquefy gelatin and do not produce pigment—these being the first of a set of tables and references in which the author hopes to include the more common forms of bacteria.

As a result, even a cursory glance at the tables show the great similarity between certain bacteria that are supposed to be different species. For example, nine species of micrococci were referred to table 2. These bacteria were isolated and described by the same authority, were obtained from different varieties of cheese, were supposed to be separate species, and yet the characteristics shown by this method are identical, and even the written descriptions point strongly to the fact that these 'species' are, at best, only varieties of the same form.

Some Experiments with Synthesized Media: M. X. SULLIVAN, Brown University, Providence, R. I.

Pasteur, Cohn and others recognized that some bacteria can secure their carbon, hydrogen, oxygen and nitrogen from simple compounds. This is to be expected from the close relationship of the bacteria to other plants. Recently the question of simple synthesized media has received some attention from Kuntz, Jordan and de Schweinitz. Since Pasteur, however, little use has been made of media other than those made of meat infusion and peptone, with agar or gelatin as a base. Meat infusion and commercial peptone vary so widely in their chemical composition and in their nutrient value, that media composed of these substances are practically of no use in the study of pigment or antitoxin production or in the study of bacterial metabolism. Analysis of standard bouillon shows such small amounts of albumoses and peptones that it appears as if we might neglect the meat infusion entirely, or at least replace the peptone by a non-nitrogenous, non-albumenous body.

On medium (A) consisting of water 100 grams, Witte's peptone 5 gms., NaCl 3 gms., agar 1 gm., 17 different kinds of bacteria, including *Microspora comma, B. anthracis, B. typhosus* and *B. coli,* grew more slowly than on the standard media.

Chromogenic bacteria, as *B. pyocyaneus* and *M. pyogenes citreus,* however, failed to produce pigment. On medium (B), made of water 100 gms., peptone 6 gms., NaCl 2 gms., $MgSO_4$ 0.3 gm., K_2HPO 0.5 gm., agar 2 gms., 15 varieties grew quickly with the production of pigment and, in one case, of phosphorescence. Then the peptone was replaced by a non-albumenous compound, such as ammonium salts or asparagin. On medium (C) containing water 100 gms., glycerin 50 gms., $(NH_4)PO_4$ 10 gms., Na_2HPO_4 1 gm., $MgSO_4$ 0.2 gm., agar 1 gm., 19 varieties grew rather slowly. On medium (D) consisting of water 100 gms., asparagin 1 gm., NaCl 0.5 gm., $MgSO_4$ 0.3 gm., agar 1 gm., 9 varieties grew with no formation of pigment. On medium (E) consisting of water 100 gms., asparagin 1 gm., Na_2PO_4 0.1 gm., NaCl 0.2 gm., agar 1 gm., 20 different kinds of bacteria, mostly pathogenic, grew as quickly as on the standard media.

Further experiments are now being carried on and, in view of the fact that so many bacteria can grow on this non-albumenous medium, it is probable that some combination of simple chemicals can be found that will replace the ordinary meat infusion. A medium consisting of such compounds, qualitatively and quantitatively known, would be of great value in the study of bacterial metabolism.

A Tank for the Growth of Germs in Large Numbers: VICTOR C. VAUGHAN, Ann Arbor, Mich.

Professor Vaughan, of the University of Michigan, described an apparatus, devised by himself, for the purpose of obtaining bacterial cells in large quantity. A copper tank ten feet long, two feet wide, and four inches deep, with a trough around the edge one inch deep, is covered by a top of the same material. This tank is supported by an iron frame with legs ten inches high, and the whole is placed on a table covered with galvanized iron. A similar tank, two inches shorter and two inches narrower, also provided with a trough around the edge and a cover, sets in the larger one, and is separated two inches from the bottom of the larger one by iron bars extending from side to side. The bottom of the outer trough is filled with water, and the seal trough of the outer tank is also filled with water, while the seal trough of the inner tank is filled with glycerin. Both lids are raised and lowered by wire ropes passing through pulleys in the ceiling. It is necessary that the tanks should be set perfectly level. Twenty liters of two per cent. agar are placed in the inner tank; both lids are lowered, and with large burners underneath the apparatus becomes a sterilizer. After repeated sterilizations, the upper lid of the outer tank is raised and the agar inoculated by pouring through tubular openings, in the top of the inner tank, a liter of a beef-tea culture of the germ. These openings are then sealed with wax and the outer lid lowered. With gentle heat underneath the apparatus becomes an incubator.

After the germ has grown for fourteen days or longer in this tank, the germ substance can, by the addition of a little water, be scraped from the agar, and from each tank there may be obtained forty or more grams of dried, pulverized germ substance.

With the colon bacillus the following facts have been learned concerning its toxin: (1) The toxin is contained within the cell from which it does not, at least under ordinary conditions, diffuse into the culture medium. (2) The toxin is not extracted from the cell by alcohol or ether. (3) Very diluted alkalis do not extract the toxin from the cell. (4) The germs may be heated in sealed tubes with water to 184° for thirty minutes, without loss of toxicity. (5) Boiling with a .2 per cent. aqueous solution of hydrochloric acid has but little, if any, effect upon the germ cell or its contained toxin. (6) Heating the germ substance for an hour at the temperature of the water-bath with water containing from one to five per cent. of hydrochloric acid lessens but does not destroy the toxicity of the cell. (7) The toxin may be partially separated from the cell wall by digestion of the whole with hydrochloric acid and pepsin. (8) With the dried bacterial cells rabbits may be immunized to the colon bacillus. (9) Rabbits thus immunized furnish an antitoxic serum. This antitoxic serum agglutinates the colon bacillus and precipitates the toxin from suspensions in water.

H. W. CONN.

WESLEYAN UNIVERSITY.

THE NEW VAPOR-ENGINES.

THE recent announcement from Berlin of the successful construction of a new 'binary-vapor,' or, as the writer has been accustomed to designate it, 'series-vapor engine,' and the almost simultaneous account in the Paris technical and scientific journals of a 'newly invented' ether-vapor engine, are reviving an old-time error. The distinction between the latter of the two systems and the former, between a fallacy and known truth, as fundamental elements of the revival of these classes of heat-engine, is once more a subject of misconception with the technical and even, often, with the scientific writers describing them.

Professor Josse, at the great Charlottenburg technical school, and his co-workers among the steam-engine builders of Berlin, have been for some time at work determining the practicability of utilizing the binary-vapor system of heat-engine, supplementing the steam-engine by a 'waste-heat engine' in which a more volatile vapor is employed to transform into useful mechanical energy the large fraction of heat rejected from the former.* The system is old, well-known and entirely correct, thermodynamically.

The real question of the moment which is sought to be solved is the practical one: With our refined systems of design, construction and manipulation, to-day, is it possible to practically, safely and conveniently and, above all, economically employ this system, often previously tried and found wanting, and to thus secure, for the user, a larger return of power for the unit of expenditure and for the life of the 'plant' than by use of the steam-engine alone? Can dividends be increased through an unquestionably greatly improved thermodynamic transformation of energy?

There is here no question of thermodynamics or of a possibility of dynamic gain; the experiment has often been tried and this possibility exhibited beyond question. It is now a matter of choice of secondary fluid, of safety, permanence of construction, convenience, reliability, ultimate gain in returns on the investment and operative costs. It is now thought, by those most familiar with the facts of this new case, that this problem has at last been solved and that the 'series-vapor engine' will find a permanent place in the arts. Time and experience will confirm or refute their conclusions.

Susini, in Paris, on the other hand, has introduced a 'new' vapor-engine in which he substitutes ether for steam, maintaining that the machine is advantageous as a primary rather than as a secondary or waste-heat engine, and, if his reporters are correct, basing his claim to this superiority upon the assertion that ether, with its volatility and low latent heat of vaporiza-

* Mittheilungen aus dem Maschinen-Laboratorium der Kgl. Techn. Hochschule zu Berlin, 1901.

tion has thus great intrinsic advantage over the vapor of water as a working fluid in the heat-engine. This is a well-known and oft-repeated fallacy, and it has been almost as common among inventors or would-be inventors as was formerly, according to Dircks, that of a '*perpetuum mobile.*'

The thermodynamic efficiency of any heat-engine is determined, at best, by the range of temperature worked through and without regard to the nature of its working substance. It is true that the practicability of employment of one or another fluid in the heat-engine varies with the temperature- and pressure-ranges and that there is as yet no known fluid which precisely adapts itself to the demand of the engineer within the practical limits of pressure and of temperature, coincidently, which he now safely, conveniently and economically handles. He finds one fluid suited to the pressure, the other to the temperature-range, one to the upper, another to the lower, portion of either scale; but he knows of none which meets his needs on both scales.

The proposition regarding 'latent' heats is easily verified by reference to the well-known expression of Rankine for the work, U_1, of the common vapor-engine cycle with complete, adiabatic, expansion between T_1 and T_2, and without compression:*

$$U_1 = \int_{p_2}^{p_1} udp = \int_{T_2}^{T_1} (JC \log_e T_1/T_2 + v_1 \, dp_1/dT_1) dT;$$

$$= JC[T_1 - T_2(1 + \log_e T_1/T_2)] + H_1(T_1 - T_2)/T_1;$$

where H_1 is the 'latent' heat of vaporization at T_1 in dynamic units.

The work of compression in the Carnot cycle, to which this cycle is reduced by its introduction, is found by making $H_1 = 0$, the compression reducing the fluid to the liquid state at the close of the compression period, when we shall have

$$U_2 = \int_{p_2}^{p_1} udp = JC[T_1 - T_2(1 + \log_e T_1/T_2)].$$

Deducting this quantity, the first expression reduces to that for the work of the Carnot cycle for vapors,

$$U_1 - U_2 = H_1(T_1 - T_2)/T_1;$$

which is identical with that for gases when, for H_1, the latent heat of vaporization, is substituted the latent heat of isothermal expansion at T^1.*

In other words, in the 'perfect-engine cycle' of Carnot, whether for one or another working fluid, or even for solids serving as working substances, the work is all performed by 'latent' heat; while, in the common steam-engine or other vapor-engine cycle, it is obtained from 'latent' heat more and more completely as the cycle approximates more and more closely to the conditions of maximum efficiency.

It is further evident from the above that efficiency is independent of the magnitude of the value of H, in the Carnot cycle, as well as of the measure of J or of C, the specific heat. As Carnot himself announced in 1824, maximum efficiency is not dependent upon the nature of the working fluid, and one vapor is as good as another in this respect. The magnitude of H determines how much heat shall be stored in the working substance in each cycle and how many units of weight of that fluid will be required per unit of work performed. Thus, with steam, a smaller number of pounds per horse-power-hour are required, other things equal, than with ether, or, in fact, with any other known substance; although the number of thermal units per unit of work developed in the

* 'Manual of the Steam-Engine,' p. 387.

* Thurston's 'Manual of the Steam-Engine,' Vol. I., p. 796.

unit of time will be the same for all. Efficiency remains the same while the quantity of working fluid circulating will vary inversely as the quantity of its 'latent' heat of vaporization.

In the actual engine, conditions external to the cycle determine the relative desirability of available fluids and extra-thermodynamic circumstances control. Since the machine has weight and is subject to friction; since the material of which it is composed is always a good conductor of heat; since the cost of production of power and that of purchase of machinery is a controlling factor; these and other, minor, conditions affecting the problem of the real engine compel the engineer to seek a working fluid that shall best combine minimum cost of fluid and of mechanism, maximum heat-storing power, maximum 'mean effective pressures' and minimum liability to heat-wastes other than thermodynamic. He is limited by pressures difficult to control safely and permanently in the steam-engine, by temperatures beyond his range of satisfactory operation in the gas-engine and by costs and risks, often very serious, with other fluids; while he finds it impracticable to utilize the lower portion of the temperature-range in the steam-engine and, in vastly greater degree, finds a similar limitation in the standard gas-engine.

No known fluid, up to this time, at least, has been found to satisfactorily combine the manageable range of temperature with the safe range of pressure in the heat-engines so as to serve as the ideal working substance. On the whole, steam has proved thus far best.

By combining fluids in series, however, it is at least ideally possible to secure this coincidence of available pressure- and temperature-ranges. Thus, it has often been proposed to utilize the rejected heat of the gas-engine in an accessory steam-engine, to thermodynamically transform the waste-heat of the latter by a secondary apparatus employing one of the more volatile liquids in a cycle of low temperature-range. Wellington attempted to find a *series* of fluids, to be worked in a number of engines in series in this manner, years ago, and every aspect of the case has been carefully studied, and usually more or less thoroughly investigated experimentally by engineers, physicists and inventors.

Nothing new in this branch of the subject has been discovered recently. It is, however, usually the fact that the earlier inventors have commonly reported a measurable gain by the substitution of the more volatile substance for steam in heat-engines. It has seldom been large; but has been sufficient to make it evident to engineers that the problem involved is not to be absolutely ignored. It seems probable that most of these available fluids possess some advantage in one if not both of two ways —higher mean effective pressures at low ranges of cycle temperatures and less freedom of heat-exchange with the metal of the cylinder.* As the former permits expansion to a lower limit of temperature, as the gain by extending the range downward is comparatively large and as wastes by internal heat-exchanges are usually serious, in the common forms of engine, the engineer is interested in watching developments in the use of other fluids than steam, though not as yet expecting much progress through their use in the simple engine.

With the 'waste-heat engine' of the 'binary-vapor system' the case is different. There exists a very large defect in the standard steam-engine in its inability to utilize the temperature-range of its cycle below about 50° C. (122° F.), while it is usually true that at least one half, and often much more than one half, of the heat-

* Thurston's 'Manual,' Vol. I., pp. 172–704, 911–921.

energy which should be transformed into work escapes transformation simply because of the low terminal pressures of the engine at the lowest temperatures of its range. It is this loss which is sought to be reduced by the series-fluid engines and which, so far as the thermodynamic and the dynamic questions are concerned, may be actually saved in large degree. The uncertainty remaining is that regarding costs, safety and convenience.

Du Trembley, about two generations ago, built binary-vapor engines, with ether as the secondary fluid, for a line of trans-oceanic steamers and 'broke the world's records' for his time in economy of power-production; but the compound engine came in and his secondary fluid proved dangerously inflammable. He lost one of his ships, Randolph & Elder bettered his record and the matter dropped out of sight. Later, many inventors have gone through the same experience in one way or another. Ether, chloroform, alcohol, ammonia, carbon-disulphide and sulphur-dioxide, among other volatile substances, have been tried, usually with some apparent gain but never yet with permanent success.

Recently, however, Professor Josse, at Berlin, has again 'broken the world's record' in heat-engine operation by producing the horse-power with an expenditure of less than eight and a half pounds of moderately superheated steam per hour. The experiment has been made with the utmost care and repeated under varying conditions, until there can remain no doubt of the fact. He further states that the steam and sulphur-dioxide, binary-vapor system adopted by him can be constructed at no greater cost than the standard triple-expansion engine which it rivals, that, properly cared for, it is not subject to injury by corrosion as had been anticipated by engineers generally, and that it can be safely insured against loss or accident through leakage. If experience confirms this claim, this means that the long-sought utilization of the waste heat of the steam-engine may be practically accomplished.

Time and experience will confirm or refute these expectations and it is for time and experience to settle the ultimate questions of the engineer relative to cost, reliability, safety and *net* gain or loss by the substitution of the series-vapor engine for the compound, the single-fluid, series-engine.

R. H. Thurston.

*WHAT ARE THE REQUIREMENTS OF A COURSE TO TRAIN MEN FOR WORK IN TECHNICAL CHEMISTRY.**

The subject before us may be discussed in two parts; first, what sort of instruction in chemistry should be given to men who are to become technical chemists, and, second, what work in other subjects should be required? Our consideration of the question will perhaps be more definite if we have before us a list of the occupations followed by a number of young men who have received training of this sort.

During the past twelve years twenty-three men have graduated from the chemical course of the Rose Polytechnic Institute. These have been employed as follows: One is inspector of coke for a large steel company, three are chemists in iron or steel laboratories, two are assayers, two are teachers, three chemists in soap factories, two employed by a firm manufacturing liquid carbon dioxide, two are draftsmen, one is superintendent of a gas company, one chemist for a firm manufacturing photographic supplies, one chemist for a paint oil company, one chemist for an electrical company, one manager of the paint department for a wholesale

* Read at the meeting of the Indiana College Association, December 27, 1901, and also at the Philadelphia meeting of the American Chemical Society.

house, one chemist for a packing company, one chemist in a testing laboratory, and one in charge of the technical science department in a large library.

No doubt the list of graduates from other technical schools would show a similar, or even greater, variety of occupations. It is at once evident that it would have been impossible to fit these men for the specific occupations which they now follow. Only in very rare instances could the occupation be predicted before graduation. Work spent upon the details of technical processes would, in the large majority of cases, have had no direct practical value. When we consider the ever-broadening scope of the chemical knowledge of our time, and the time limits which are practically set for the student's work, we cannot doubt that time spent in laying broad and solid foundations will be much more useful than any great amount of time given to the details of industrial chemistry.

At the basis of all must come a thorough training in analytical chemistry, and especially in quantitative analysis. While I think that the laboratory work should begin with work in general chemistry and that should be followed by qualitative analysis, no very large amount of time should be given to either by students who are to become chemists. Fifteen hours a week for one half to two thirds of a school year should be sufficient. The work given in general chemistry should be directed toward the illustration of fundamental principles and instruction in accurate manipulation with varied forms of apparatus, rather than to a large amount of detailed demonstration of the properties of elements and compounds. Beyond a very limited amount of the latter kind of study, the attention of the student will weary and he will acquire the fatal habit of performing experiments as directed, writing descriptions in his note-book and straightway forgetting all about them. The same is even more true of some kinds of work often given in qualitative analysis. The greater length of time required for quantitative operations, and the comparative simplicity of the processes involved, are better suited for training the beginner in the accurate memory of detail which is so useful for the chemist.

In the selection of topics in quantitative analysis I heartily believe in beginning with pure salts, which give a rigorous test of the student's accuracy. After a limited number of such determinations, however, the student's work is best directed to the analysis of various commercial products, the object being to give as varied a training as possible and a knowledge of the most practical methods. In general, a reasonable economy of the student's time should be considered and long and tedious methads should not be used, especially when shorter methods give as good or better results. The determination of the principal constituents of iron and steel, determination of iron, copper, zinc and lead in ores, assaying for gold and silver, the determinations of sanitary water analysis, coal analysis, and gas analysis should be included for every student. One or more complex analyses, as a clay analysis or an analysis of a mineral water are also very desirable, and beyond this many special topics may be assigned to individual students. No hard and fast course should be laid down to be followed by all alike. At some point the quantitative work should be broken off and a few weeks given to inorganic preparations, and a few weeks, at some other point, to organic preparations. There should, of course, be lecture courses in general and organic chemistry and in the history and theories of chemistry. The lecture work in physical chemistry should be supplemented by laboratory work.

It is the custom, at all of our best technical schools, to require a thesis for graduation. This thesis should always be based on careful experimental work continued for some months. It should, if possible, contain some real addition to the world's knowledge. The student cannot be expected to select, independently, a suitable topic. Indeed, where the higher degree of Doctor of Philosophy is concerned, students rarely select their own subjects. The wish of the students as to the nature of the topic should, however, be consulted. Subjects pertaining to industrial chemistry are especially appropriate, but topics pertaining to the pure science are not to be excluded, and indeed are often to be preferred because of the broader and deeper insight which they give to the student. Every technical school should hold before itself not only the purpose of giving to its students a sound preparation for industrial pursuits, but it should also contribute constantly to the increase of knowledge in those fields with which it has to deal. The reflex influence of such ideals on the instruction given is of the greatest possible importance.

The second phase of our question pertains to the accessory studies which the chemist should have. There seems to be a very prevalent notion that a chemist needs very little mathematics. With the rapid development of physical chemistry and the application of that branch of chemistry to technical problems which is soon to come, if not already here, such a view is no longer tenable. Every chemist, and indeed every one dealing with physical science, should have, at least, a knowledge of the calculus. In physics, a thorough knowledge of fundamental principles should be given and especial attention should be devoted to the subject of electricity. The methods used by engineers in testing structural materials should be acquired by actual use of the instruments employed for the purpose. Free-hand and mechanical drawing are almost necessary and some work in machine design is very desirable. In language, a reading knowledge of German and French should be acquired and the knowledge should be practically used in connection with current chemical journals. Except for lack of time I should advocate some work in biology. But, while there are fields in industrial chemistry where some knowledge of biology is absolutely essential, and while all chemists should know something in a general way about bacteriology, room can scarcely be found for these subjects without displacing something of more vital importance. In conclusion, I would say that the accessory subjects, especially, should not be slighted by the student. If he becomes a chemist he will certainly learn a very great deal about chemistry after he leaves school, but much of this other knowledge he is far less likely to acquire afterwards, and very much of it he will find practically useful if it is at his command.

William A. Noyes.
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SCIENTIFIC BOOKS.

Plane and Solid Geometry. By Arthur Schultze, Ph.D., and F. L. Sevenoak, A.M., M.D. The Macmillan Company, New York.

The results of geometrical teaching in England are rather disappointing, if we are to judge by the reports and criticisms that have appeared in educational journals and scientific reviews. The blame is laid entirely on the system adopted, which is Euclidean pure and simple, and from which the universities and other examining bodies are unwilling to depart. It is good to be conservative; but it is also easy to overdo it. "Surtout pas trop de zèle" was Talleyrand's famous injunction. It applies as well to conservatism in pedagogics as it does to conservatism in politics. Euclid's text was excellent in his day and for his purposes, and continued so for many a century.

The educational wants of our age are far more numerous, pressing and diverse than when the Greek geometer taught in the schools of Alexandria 2,300 years ago. We must remember, too, that it was before admiring throngs of men that he unfolded book after book of his 'Elements,' men who were attracted round his cathedra more by the knowledge that he had to impart than by the mental training to be derived from his teaching. The geometrical truths that Euclid discussed before his mature scholars have to be placed to-day before the undeveloped minds of mere tyros and placed before them as only one of the many elements of their daily pabulum.*

The necessities of our times call for less verbosity, prolixity and iteration than we find in Simson's rendering of Euclid, which is the orthodox text in English schools modified somewhat by Todhunter, Hamblin Smith, Mrs. Sophia Bryant and others. The whole presentation of the subject is decidedly hard and deterrent. Think of Book II. and especially Book V., also Books XI. and XII., and try to realize the hardship, the worry and vexation of spirit they have caused! A different sequence of propositions is needed, as well as shorter demonstrations and modern methods. When we want to cross a stream, we do not go up one bank to its source and down the other; but avail ourselves of a bridge, a ferry or an electric launch if handy.

Nor is prolixity the only salient fault of Euclid's 'Elements'; it lacks suggestiveness and fails to adequately stimulate the inventive faculty of the student. It leaves him but too often unable to think out a simple matter for himself, to originate a plan of attack or even to act on a hint. He can appreciate a neat solution to a rider; he is receptive, but not creative enough; a good consumer but poor producer.

On the other hand, we have found boys very different who had worked out their Davies or Robinson or other simplifier or improver of Legendre's great work. They had a clearer apprehension of the meaning of geometrical truths and firmer grasp of them. They usually showed marked readiness in applying their knowledge, in extending conclusions, detecting flaws and attacking problems. There was a resourcefulness and a vigor about their ways that bespoke the benefit which they derived from the subject. It was less a task imposed upon them than a congenial study. Here, then, we have the full realization of the twofold end of all undergraduate study, viz., culture and utility; or, to put it otherwise, the awakening of the faculties and the acquisition of knowledge.

Euclid might well say to Ptolemy that there was no royal road to geometry; but all the same, such a work as the 'Plane and Solid Geometry' of Dr. Sevenoak and Dr. Schultze will go far toward smoothing the way for the young geometer and inspiring him with a liking for the subject. The letterpress and figures leave nothing to be desired; the demonstrations are well spaced, short and suggestive. The arrangement of the propositions follows a logical and pedagogical order, and the exercises, which form an integral part of

* Here are the latest from *Nature* of January 16, 1902: "Mr. W. C. Fletcher, headmaster of Liverpool Institute, says that 'six years' experience in teaching geometry has led him to believe that Euclid is a great hindrance to ninety-nine boys out of every hundred in training and knowledge. A great deal of damage is done by insistence, not only upon the particular method, but on the particular order of Euclid" (p. 262).

A letter signed by mathematical teachers in the great public schools of England such as Eton, Harrow, Rugby and Winchester contains the following momentous acknowledgments: "It may be felt convenient to retain Euclid; but perhaps the amount to be memorized might be curtailed by omitting all propositions except such as may serve for landmarks. We can well dispense with many propositions in the first book. The second book, or whatever part of it we may think essential, should be postponed till it is needed for Book III., 35. The third book is easy and interesting; but Euclid proves several propositions whose truth is obvious to all but the most unintellectual. The fourth book is a collection of pleasant problems for geometrical drawing; and in many cases, the proofs are tedious and uninstructive. No one teaches Book V." (p. 258).

the work, bear evidence of having been selected for the purpose of gradually and systematically leading the student to do some independent thinking and original work. From every point of view this elementary work on 'Plane and Solid Geometry' is a commendable text-book. M. F. O'Reilly.

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Zoology: An Elementary Text-book. By A. E. Shipley, M.A., and E. W. MacBride, M.A. (Cantab.), D.Sc. (Lond.). New York, The Macmillan Company. 1901.

This is a neatly gotten up general zoology of xxii and 632 pages, with 349 text figures. The text is divided into 23 chapters, of which the first is an introduction of 12 pages briefly reviewing the properties of living things and defining a number of general terms and phrases. The remaining pages are apportioned in order as follows: Protozoa 27, Cœlenterata 29, Porifera 7, Introduction to the Cœlomata 6, Annelida 28, Arthropoda 87, Mollusca 39, Echinodermata 40, Brachiopoda 6, Polyzoa 5, Chætognatha 4, Hemichordata (*Balanoglossus*) 5, Cephalochordata (*Amphioxus*) 14, Urochordata (Tunicates) 9, Craniata 259, Platyhelminthes 21, Nemertinea 5, Rotifera 8, Nematoda 6, Index 16.

Putting aside likes and dislikes, one must admit that this is a pretty fair distribution. We cannot, however, see what is gained by considering the Cœlenterata before the Porifera, and the Flatworms, Roundworms, Nemerteans and Rotifers after the Mammals. Logical and natural sequence of generalizations is not without distinct value and interest, and from this point of view such an apparently insignificant matter of detail as intervening the Cœlenterata, or any other group, between the Protozoa and Porifera becomes important.

On the whole, the treatment of the phyla is good. In each group of animals some more or less representative form is described in considerable detail, and other forms of interesting habits or having a bearing upon some principle or generalization are noted. The systematic tables avoid the shoals of details and briefly characterize only the phyla, classes, subclasses, orders and suborders. Under the final division of the group considered one to three genera are named as examples. The book being an English one, we are not surprised to see American forms somewhat slighted. The nomenclature is not always the most modern, but that is a matter of such minor importance in an elementary text that it may be overlooked. In some respects the authors have not always lived up to the excellent principles laid down in the preface. With them we believe technical terms and phrases should, so far as practicable, be elucidated in connection with the first presentation of forms illustrating them. We naturally expect to find radial symmetry noted in connection with the Cœlenterata, but it is first mentioned on page 80 in the introduction to the Cœlomata. As a rule the principle is lived up to in good shape. The very limited space given to embryology and physiology is in our opinion a real defect. It would have been better to make room for more of this by cutting out portions of the general accounts. We also believe that taking up a phylum by beginning with a consecutive account of some form as a type is the proper plan for an elementary text-book. In this respect the treatment of the Arthropoda, which is comparative, is inferior to that of the Annelida and other phyla.

To write a good text-book on zoology is no easy task, and to write one acceptable to every one is an impossibility. The most that should be expected of a text-book is positive and continuous assistance to teacher and pupil. Successful teaching lies with the teacher and not in the text-book.

The book before us is well gotten up. The typographical work is good, the figures as a rule are clear and the page is clean and inviting. While in some respects it still leaves room for improvement, we consider it one of the best and most worthy of recent elementary text-books on zoology.

Henry F. Nachtrieb.

Gustav Theodor Fechner. Rede zur Feier seines hundertjährigen Geburtstages gehalten von Wilhelm Wundt. Leipzig, Engelmann. 1901.

In his address delivered at the centenary of Fechner's birth, Professor Wundt does not attempt to give a *full* outline of the philosophical and scientific views of this last of the great German philosophers of the nineteenth century. He states at the outset that his object is to speak of the relation between Fechner the philosopher and Fechner the scientist, and he succeeds admirably in showing the fundamental connection between the religious mysticism of Fechner and those rigorously exact investigations which led to the establishment of the science of psycho-physics. He shows with a delicate touch, a keen insight and in masterly form, how originally purely metaphysical ideas resulted in the establishment of principles which lifted this new science for all future times above the danger of any subjective views. Professor Wundt defends Fechner the scientist against Fechner the philosopher and Fechner the poet, and apparently does not believe that the metaphysical speculations of the '*Innere Psychophysik*' will have many adherents in the future; he compares these aptly with Kepler's mystic '*world-harmony*' now forgotten, but valued by its author more than his immortal third law. The lasting service of Fechner, according to Wundt, consists in the fact that he for the first time introduced 'exact methods, exact principles of measurement and experimental observation into the investigation of mental life' and that, in consequence, he was the first to make a scientific psychology possible.

Wundt's pamphlet contains, besides, several interesting '*Addenda*': Personal Reminiscences, an essay on Fechner's relation to the natural philosophy of Oken and Schelling, on his philosophical method, his psychology, his attitude towards spiritism and a list of his principal works. Wundt's essay will serve as an excellent introduction to the world of thought contained in the works of Fechner, which are far too little known in this country, and which even in Germany are only beginning to take the rank which is due to them in the study of the history of philosophy.

If a further guide to the study of Fechner should be desired, we would suggest to take up after Wundt's essay, R. Seydel's paper on *Religion und Wissenschaft* (Breslau, 1887), W. Bölsche's Characterbild (*Deutsche Rundschau,* Sept., 1897), and K. Lasswitz' critical Biography (1896), which last is still unsurpassed and far preferable to the biography compiled by Kuntze, written from the one-sided standpoint of an orthodox theologist.

EWALD FLÜGEL.

STANFORD UNIVERSITY, CAL.

SCIENTIFIC JOURNALS AND ARTICLES.

The Plant World for January contains an illustrated article on 'The Missouri Botanical Garden,' by the Director, William Trelease; 'A Visit to the Royal Palm Hammocks, Florida,' by Charles T. Simpson; 'Plant Agencies in the Formation of the Florida Keys,' by Charles L. Pollard, besides the usual briefer articles. The Supplement, devoted to the families of flowering plants, contains the first portion of the Orders Opuntiales and Myrtifloræ.

Bird Lore for January–February opens with 'Recollections of Elliott Coues,' by D. G. Elliot and C. A. Curtis, in which we are told something of his youth and of his first army detail. 'The Western Evening Grosbeak' is described by Wm. Rogers Lord, and in 'Bird Clubs in America' Francis H. Allen tells of the Nuttall Club, the article being accompanied by a capital plate showing the President, Mr. William Brewster, and a number of the members. Frank M. Chapman contributes the second of the papers on 'How to Name the Birds,' which runs through the Corvidæ, and then follows 'The Christmas Bird Census' taken in many parts of the country, while Fred T. Morison contributes 'The Prize Crow Story.' In 'A Midwinter Meditation,' M. O. W. intimates that nature study may be so misdirected as to be decidedly harmful to the birds.

Popular Astronomy for March includes a paper entitled 'A Laboratory for General Astronomy,' by Miss Mary E. Byrd, of Smith College, and an illustrated article by Percival Lowell on the north polar rifts and the arctic canals on Mars. Other articles are by W. F. Denning on 'Real Paths of Brilliant Meteors'; by J. C. Kapteyn, J. K. Rees and W. H. Pickering, 'On the Motion of the Nebulæ in the Vicinity of the Nova Persei.' The Rev. Q. A. Wheat concludes his series of papers upon the 'Eclipse Aid to Chronology,' and Dr. Wilson contributes further observations of the 'Light Curve of the New Star in Perseus.'

The first number of a botanical monthly, called *The New Phytologist* has appeared in England. Professor A. G. Tansley, of the University College, London, is its editor and the subscription price is 10 shillings a year. This journal will seek to satisfy an apparent need in Great Britain for a botanical journal with educational aims uppermost. Accordingly especial attention will be given to discussions of scientific questions, methods of teaching and research, notices of important books and papers and preliminary notes. Realizing the labor and sacrifice which such an undertaking involves, we wish Professor Tansley every success and trust that he will obtain cordial support from this side of the water.

SOCIETIES AND ACADEMIES.

THE IOWA ACADEMY OF SCIENCES.

The sixteenth annual meeting of the Iowa Academy of Sciences was held in Des Moines on December 26 and 27, Professor A. A. Veblen presiding. The meetings were well attended and much interest was taken in the program. Thirty papers were presented, many of the more technical being read by title.

The address of the retiring president, Professor A. A. Veblen, was on 'The Relation of Physics to the other Material Sciences.' Physics was the first of the material sciences to develop the modern methods of research. The other branches are greatly indebted to physics for the aids it furnished them, and they in turn are under obligation to physics for the help it has rendered them. Professor Veblen also described several models; one to show the transmission of a wave by transverse vibration; another to illustrate the longitudinal or sound wave; and a third for compounding simple harmonic motions.

'Preliminary Notes on the Flora of Western Iowa, especially from the Physiographical Ecological Standpoint,' was the subject of a paper read by Professor L. H. Pammel. The effects of the soil, climate, altitude, temperature and rainfall on the flora of the region were considered. The flora of the different physiographic regions was given, including the plants of the Missouri floodplain, the bluffs and the upland.

Professor Herbert Osborn presented a paper on the 'Factors of Extinction.' More attention has been devoted to the factors concerned in the production of new types than to the factors of extinction. It is worth while to attempt to formulate those factors which are especially concerned in the elimination of life forms. They were summarized as follows:

(1) That extinction which comes from modification or progressive evolution, a relegation to the past as a result of the transmutation into more advanced forms. (2) Extinction from changes of physical environment which outrun the powers of adaptation. (3) The extinction which results from competition. (4) The extinction from extreme specialization and limitation to special conditions the loss of which means extinction. (5) Extinction as a result of exhaustion.

Professor Maurice Ricker described a 'Large Red Hydra,' found in large numbers in Echo Lake, Flathead County, Montana. The animals are bright coral red in color and the larger ones measure when feeding five eighths of an inch from mouth to proximal end. None of the tentacles was less than two and one-half inches long. So far as known, no other hydra has ever been collected in the State.

The following officers were elected for 1902: *President*, H. E. Summers, of Iowa State College, Ames, Iowa; *First Vice-President*, J. L. Tilton, of Simpson College, Indianola, Iowa; *Second Vice-President*, S. W. Beyer, of Iowa State College, Ames, Iowa; *Secretary*, A. G. Leonard, of the Iowa Geological Survey, Des Moines, Iowa, and *Treasurer*, B. Shimek, of the State University, Iowa City, Iowa.

A. G. Leonard,
Secretary.

THE GEOLOGICAL SOCIETY OF WASHINGTON.

AT the meeting of the Society on February 12 the first paper was by Mr. G. P. Merrill and was entitled, 'Rutile Mining in Virginia.' Mr. Merrill called attention to the fact that recent experiments in the making of cast iron and steel had called for titaniferous alloys. As a result of this, a rutile deposit, situated on the Tye River, near Roseland post-office, Nelson County, Va., had been opened up. The country rock is a strongly foliated gneiss traversed by dikes of hypersthene diabase. The rutile occurs associated with a coarsely crystalline quartz feldspar rock, the exact nature of which has not yet been made out, but which, from the size of the deposit and its crystalline nature, is judged to be eruptive. The rock is a coarsely crystalline aggregate of potash and soda-lime feldspar, of a light gray color, through which are disseminated small rutiles. With it is associated bluish, opalescent quartz, which occurs under such conditions as to suggest that it is not the result of primary crystallization.

In a brief paper entitled, 'Notes on the Geology of the Klondike,' Mr. W. C. Mendenhall sketched the general relations of the rocks in the mining district tributary to Dawson, so far as they are known, and outlined the relations borne by the gold-producing creeks to the geology. A brief account of the occurrence of the gold in the present stream gravels and on the terraces which mark older stream courses was given, and the probability that the gold was derived from stringers or lenses in the schists which are cut by the streams and has not been transported for any distance was brought out.

Mr. Arthur C. Spencer presented a paper on 'The Manganese Ores of Santiago Province, Cuba.' All the manganese produced in Cuba has been shipped from Santiago, the chief city of the easternmost province. The deposits are found back from the coast and are distributed over an extended region. In their mode of occurrence they are replacements of limestone and of calcareous green-sands in localities that have suffered disturbance and folding. From the association of jasper, also replacing calcareous rocks, it is believed that hot circulating water has been active in the formation of these valuable deposits.

Mr. Whitman Cross spoke of the evolution of ideas on systematic petrography in America, referring to the conservative attitude of geologists, presented in text-books, as represented by J. D. Dana; to the propositions for the classification of volcanic rocks presented by Clarence King, regarding them as the only true igneous rocks; and to the proposition made by M. E. Wadsworth. Concerning the part played by petrographers of this country in shaping existing systems, it was pointed out that while but few original proposals of note had been made, the results of the many investigations had almost unconsciously caused a gradual evolution of opinion, even without the influence of any American system.

Mr. R. H. Chapman exhibited some interesting photographs showing stratification in mine dumps.

ALFRED H. BROOKS,
Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON.

THE 349th meeting was held on Saturday evening, February 8.

Dr. C. A. White gave a review of 'The Mutation Theory of Professor de Vries,' giving an outline of his experiments with various plants which had led to his conclusion that evolution was not always a slow process, but that under certain conditions might take place rapidly, and that there was a period in the growth of a race of plants or animals when it was particularly susceptible to external influences.

The paper will appear in the next 'Report' of the Smithsonian Institution.

Henry W. Olds presented 'Some Deductions from the Study of Bird Songs,' prefacing his remarks with the statement that the conclusions he was about to present were merely tentative, but, if corroborated by subsequent investigations, of much importance from their bearing on the question of the evolution of music. Music, he stated, seems to be popularly regarded as artificial and musicians apparently consider it largely, if not entirely, governed by fixed laws, while certain students of the philosophy of the art, such as Helmholtz, Hanslick, Pole and others, believe that the truth lies between these two extremes—that the fundamental rules are governed by physical laws, while more complex questions of form are mainly, at least, arbitrary. The history of music appears to sustain the last view. The evolution of the diatonic scale, the comparatively recent rejection of all modes but the modern so-called major and minor, the absence of rhythm, as we know it, until about the eleventh or twelfth centuries, and of tonality, or reference in melody to a tonic or keynote, until the seventeenth century, all seem to support the theory that many present æsthetical rules of music are temporary and fortuitous and probably of no greater validity than those they have superseded. The octave, fifth and fourth of the modern scale are excepted, by those who hold this view, as resting upon a physical basis; but the other intervals are held to be arbitrary; and the necessity to the modern ear of a definite key, and all the requirements comprised under the term 'form,' are regarded as mainly casual, not necessarily indicating any advance toward a fixed ideal.

But if we find bird music undergoing an evolution that parallels our own progress—if advance in each independently follows the same lines, we have excellent evidence that there is an ideal standard toward which all progress must tend, a law which determines the direction of development of our æsthetical rules. A study of the songs of the birds seems to support this idea. Many birds, as for example the Carolina wren, wood thrush, chickadee and chewink, use the intervals of the modern scale. Birds songs are often rhythmical and may be divided into regular measures properly accented; and several of the formal rules of human music may be found governing the music of the birds.

Mr. Olds gave examples illustrating this statement. These included bits of melody satisfying to the human musical taste, phrases repeated on the same or a different pitch, antiphonal phrases coupled together by a single bird, or by two, with evident intention, and one instance of a song (by the wood pewee) in which the rules of construction governing many ballads were followed. These Mr. Olds said were a few of the instances he had noted indicating a parallel and independent musical evolution and so leading to the conclusion suggested, but he wished to investigate further before positively announcing a principle opposed to the weight of authority and apparently in conflict with previous evidence.

F. A. Lucas.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

The 546th meeting was held February 1, 1902, Vice-President Marvin in the chair.

Professor Simon Newcomb spoke on 'Recent Views of the Universe.' He called attention to the probability that the density of most stars is much less than that of the sun and the temperature higher; if the sun were removed to the same distance as the stars some of them would appear only 1/100 as bright as it, while *Canopus* and *Rigel* would be more than 1,000 times, probably 10,000 times, as bright. The probability is that most stars have dark bodies revolving around them. Our system is, so far as we know, very unusual in having circular orbits; the stellar orbits are generally quite eccentric, and life such as we know could not probably exist under the extremes of temperature prevailing near any star. The distribution of the stars appears to be remarkably symmetrical around the axis and plane of the Milky Way. The thinning out is slight up to a parallax of .01 second, and the stars extend to at least 1,200 times the distance of *α Centauri*. It is possible that the apparent limit may be due to absorption of light, caused for example by cosmic dust. Reference was made to Lord Kelvin's and J. J. Thomson's recent papers and the fact pointed out that all the new stars are in the Milky Way and therefore probably have a very small parallax, perhaps .001 second, more or less.

Professor F. H. Bigelow, of the Weather Bureau, spoke on 'Aristotle's Physics and Modern Physics.' Aristotle's profound work on the fundamental principles of nature ought to be better known to modern students. He defended the theory of nature which avoids both the extreme idealist view and the extreme material view, and developed the theory of evolution from an inner potential which we now call life. He denied that atoms exist in a vacuum, but held that they possess mutual forces in a plenum. The recent views advanced by Lord Kelvin that the ether is imponderable or non-gravitational matter, and that action at a distance is the law of atoms, seem like a close return to the theory held by Democritus and Aristotle, and in this respect there is agreement between ancient and recent theories. But the startling theory advanced by Lord Kelvin that atoms and ether can occupy the same space identically is of course not in agreement with Aristotle. It is very well worth noting that many points of modern physics were anticipated by Aristotle.

Mr. A. L. Day, physicist of the Geological Survey, began a paper, 'On the Measurement of High Temperature.' An abstract will be deferred till the paper is concluded.

CHARLES K. WEAD,
Secretary.

ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

THE 326th regular meeting was held January 28. Dr. J. Walter Fewkes exhibited a stone idol from Casas Grandes, Chihuahua, and, commenting on the resemblances of the ruins of northwestern Chihuahua and those of the Gila Valley, said that relief design characterizes the pottery of Casas Grandes, and that while this feature does not prevail in the Gila Valley, the ware is similar to that in the ruins of northwestern Mexico.

President W. H. Holmes, in discussing this paper, traced the distribution of relief work or life form in the United States and Mexico.

Major J. W. Powell's paper, 'An American View of Totemism,' was read by Mr. J. D. McGuire and was discussed by Mrs. M. C. Stevenson, Dr. J. W. Fewkes, and Professor W J McGee.

'Orenda and a Definition of Religion,' by Mr. J. N. B. Hewett, provoked much discussion and the subject was continued for consideration at the next meeting. Orenda is an Iroquoian word meaning mystic potence or magic, and is advanced to supplant the word animism, which seems not adequate to express this elusive belief. Messrs. McGee, Fewkes and Pierce spoke in favor of adopting this word, but Miss Alice Fletcher thinks the word will not cover all forms of belief among our tribes.

WALTER HOUGH.

THE NEW YORK ACADEMY OF SCIENCES.

THE annual meeting of the New York Academy of Sciences was held at 108 West 55th Street on Monday, February 24, at 8:15 P. M., President R. S. Woodward presiding.

The reports of the officers for the last year showed that the affairs of the Academy were in a much more favorable condition than the year previous. The recording secretary reported that the Academy had 298 resident members, of which 92 were fellows, and that the principal work of the council during the year had been that of bringing about a revision of the constitution which would enable the Academy to carry on its work in accordance with the needs of science in New York City. A bill has just been passed by both houses of the State legislature, allowing a revision of the charter, which will enable the Academy to revise its constitution and bylaws, which will very shortly be done.

The publications of the Academy during the year have been small, owing to restricted appropriations; but through economy the finances have been straightened out, and the Academy opens the new year auspiciously. The principal paper besides short ones published in the *Annals*, Volume 14, has been that of Dr. Bashford Dean, entitled 'Paleontological Notes,' and printed as a Memoir, Volume 2, Part 3.

The library of the Academy continues to be housed in Schermerhorn Hall, Columbia University, and is rich in scientific serials, which are kept up to date largely through exchange.

The following honorary members, selected because of their eminent scientific services, were unanimously elected: James Dewar, M.A., LL.D., F.R.S., Jacksonian professor of experimental philosophy, University of Cambridge, England, 21 Albemarle St., London, England; William James, M.D., LL.D., Ph.D., Litt.D., professor of philosophy, Harvard University, Cambridge, Mass.; Wilhelm Wundt, Ph.D., M.D., professor of philosophy, Leipzig, Germany. The number of honorary members is restricted to fifty.

The following resident members, because of their 'scientific attainments or services' to the Academy, were promoted to fellows, in accordance with the by-laws and constitution: Maurice A. Bigelow, Ph.D., Teachers' College, Columbia University; Professor Hermon C. Bumpus, American Museum of Natural History; O. P. Hay, Ph.D., American Museum of Natural History; E. O. Hovey, Ph.D., American Museum of Natural History; W. D. Matthew, American Museum of Natural History; S. J. Meltzer, M.D., 166 West 126th Street.

Ballots were then distributed, and votes counted, and the following officers were elected for the ensuing year:

President, J. McKeen Cattell; *First Vice-President,* Nathaniel L. Britton; *Second Vice-President,* Richard E. Dodge; *Corresponding Secretary,* Bashford Dean; *Recording Secretary,* Henry E. Crampton; *Treasurer,* Charles F. Cox; *Librarian,* Livingston Farrand; *Councilors,* Franz Boas, Hermon C. Bumpus, D. W. Hering, Frederic S. Lee, Chas. Lane Poor, L. M. Underwood; *Curators,* Harrison G. Dyar, Alexis A. Julien, George F. Kunz, Louis H. Laudy, E. G. Love; *Finance Committee,* John H. Hinton, John H. Caswell, C. A. Post.

The president and recording secretary-elect then assumed charge of the meeting, and the retiring president delivered his annual address, entitled 'Measurement and Calculation.' At the close of the address a vote of thanks to the president was carried on motion of Professor Henry F. Osborn, and the academy adjourned.

Richard E. Dodge,
Recording Secretary.

DISCUSSION AND CORRESPONDENCE.

THE UNION AND RIVERSDALE FORMATIONS IN NOVA SCOTIA.

To the Editor of Science: In your issue of January 17, 1902, Vol. 15, No. 368, on page 90, the title and abstract of my second paper read before the Geological Society of America, held in Rochester, are given, which require a slight emendation. The following exact title and brief abstract are herewith submitted:

Title: 'The Meso-Carboniferous Age of the Union and Riversdale formations in Nova Scotia.'

Abstract: From internal paleontological evidence the Union and Riversdale formations are clearly Middle or Meso-Carboniferous. The insect, reptilian, lamellibranchiate, crustaceous and other associated faunas, as well as the floras entombed in the Riversdale shales and sandstones, according to R. Kidston, of Stirling, Scotland; David White, of the U. S. National Museum, Washington; Dr. Wheelton-Hind, of Stoke-upon-Trent, Eng.; S. H. Scudder, of Cambridge; Henry Woodward, of the British Museum, London, Eng., indicate a typical Carboniferous horizon, which, when compared with similar faunas and floras elsewhere, lead one to state that a Meso-Carboniferous age is here represented.

In Cumberland County, Upper Carboniferous limestone beds, formerly classed as Lower Carboniferous, are thrust over siliceous shales and sandstones, etc., presumably of Meso-Carboniferous age, formerly classed as Devonian and referred to the 'rocks of Union' or Union formation. In Pictou and Antigonish Counties, Lower Carboniferous strata rest uncomformably upon the upturned Eo-Devonian, with which the Union and Riversdale formations were formerly correlated by stratigraphers.

H. M. Ami.

Ottawa, January 28, 1902.

HIGH WATER IN THE LAKES OF NICARAGUA.

The numerous heavy flooding rains in Western Nicaragua and consequent rapid rise to unusual height of the water in Lakes Nicaragua and Managua (connected with each other by Rio Tapitapa) in November of last year, indicated that in February, 1902, the water in those lakes would be higher by several feet than the usual annual high water mark, or than since 1859 to 1861, when the height was about 12 feet above the average, and, consequently, that earthquakes and volcanic activity would occur.

The continuous rapid dry current of atmosphere passing over those lakes since the 20th of December, 1901, and the warm temperature has caused unusually great evaporation so that the water in those lakes is only about four feet higher at this date—February 9, 1902—than usual at this time of the year. There is also but slight increase of volcanic activity, indicated by an increased flow of gases and vapor from volcanic peaks. Only seven earthquakes in Western Nicaragua have occurred since November 15, each slight, from II. to IV. of the Rossi-Forel scale.

There are no indications of higher water in the Lakes this year. J. CRAWFORDES.

MANAGUA, NICARAGUA,
February 9, 1902.

UNIO CONDONI IN THE JOHN DAY BEDS.

PROFESSOR J. C. MERRIAM informs me that he 'found great quantities of that species at the original locality.' As this form was not among the material sent to me for determination, I erroneously inferred that it had not been detected. The original locality, as stated by Dr. White, is the North Fork of John Day River, Oregon, at the angle of the big bend, longitude 119° 40′, latitude 44° 50′. My paper in SCIENCE January 24 last, pages 153–154, is hereby corrected in this particular.

ROBT. E. C. STEARNS.

NOTES ON INORGANIC CHEMISTRY.

THE NEW SULFURIC ACID MANUFACTURE.

ATTENTION has often been called within the last few years to the new process of making sulfuric acid from the pyrites-burner gases without the intervention of lead chambers, but the first authoritative description of the process, with the history of its development, was given in a lecture last fall by Dr. R. Knietsch before the German Chemical Society. This lecture has now been published in the *Berichte* of the Society and deserves notice, not only on account of the intrinsic importance of the subject, but also as being a conspicuous example of how the persistent investigations of trained chemists have succeeded in overcoming what seemed to be insuperable obstacles.

The catalytic action of platinum upon mixtures of gases was discovered by Sir Humphrey Davy in 1817, and in 1831 Peregrine Phillips, of Bristol, England, took out a patent for the manufacture of sulfuric acid by the action of finely divided platinum upon a mixture of sulfur dioxid and oxygen. This process, though exploited from time to time, and worked at by many chemists, came to nothing. In 1875 Clemens Winkler took up the study of this reaction, finding that the most favorable condition for this reaction is when the gases are present in the proportion of two volumes of sulfur dioxid to one of oxygen, and that the presence of other gases or even of an excess of either of those involved in the reaction is detrimental. Since, by decomposition, ordinary sulfuric acid yields a mixture of sulfur dioxid, oxygen and water, it was possible to utilize these gases in the manufacture of sulfur trioxid or of fuming sulfuric acid, by drying them to remove the water, and then leading them over platinum sponge. This was put into practical application with some success. This can, however, hardly be considered more than a very slight step toward the manufacture of ordinary oil of vitriol from the pyrites-burner gases.

The rapidly increasing development of the color-industry of Germany has occasioned a demand for enormous quantities of both concentrated and fuming sulfuric acid, and for the past decade the energies of the chemists of the great color corporations have been directed toward the problem of the manufacture of these acids without the intervention of the lead chambers and the platinum concentration stills. In these investigations Dr. Knietsch, of the Badische Anilin- und Soda-Fabrik, was a most important factor, and to him belongs a great share of the credit of having rendered the new process a commercial success.

The gases from the pyrites-burners consist of sulfur dioxid, nitrogen and an excess of oxygen from the air. When these gases were thoroughly purified and carried to the laboratory it was found that on passing over a 'contact mass' containing finely divided platinum, the sulfur dioxid was completely oxidized to the trioxid, or to sulfuric acid if water was present. When, however, an attempt was made to carry out the operation on a large scale, the contact mass quickly became inert. This was the case even when the gases had been purified by passing through long pipes, repeated washing with sulfuric acid, and further passage through coke and asbestos filters. In following up the cause of the difficulty, it was found that extraordinarily small quantities of arsenic were capable of inhibiting the action of the platinum in the contact mass. The same is true of a few other substances such as mercury and perhaps phosphorus. These substances seem to have what may be considered a poisonous action upon the platinum. Investigation showed that the arsenic was contained in the fine white fume which is formed in all cases where sulfur is burned. This fume consists of finely divided sulfuric acid, and its complete condensation has been one of the unsolvable problems of technical industry, especially in connection with smelting plants. Eventually the problem was solved by the thorough washing and wet filtration of the slowly cooled gases, with water or dilute sulfuric acid.

After this purification from every trace of mechanical impurity, as was shown optically, it was found that the contact mass still lost its activity after a time, and here again patient investigation revealed the fact of arsenic poisoning. This was finally shown to be due to the action of the condensed sulfuric acid from the burners upon the iron condensers, whereby traces of arseniuretted hydrogen (arsin) were generated. This difficulty was easily overcome, but when the process was attempted on a large scale, it was still unsuccessful. When the pyrites burners were used to their full capacity, there was formed a fume which resisted every attempt at condensation. This was unconsumed sulfur, which, of itself harmless, contained minute quantities of arsenic, thus again poisoning the contact mass. The formation of this fume was prevented by the injection of steam into the burners, which has other advantages, in preventing the action of the condensed acid on the iron pipes, and in hindering the formation of hard dust scales in the cooling pipes and chambers. Other difficulties appeared in the cooling of the contact mass and in connection with the absorption of the sulfur trioxid, which is attended by a great development of heat, but they were slight in comparison with those which had attended the purification of the gases. At last the process was established on a commercial basis, as is shown by the fact that in the year 1900 the production of sulfur trioxid reached the amount of 116,000 tons.

The first interest of the process is of course for the manufacture of the concentrated and fuming acids, used largely in the color industry, but when it is considered that it is the concentrated acids which are most economically made in this manner, it is not difficult to foresee that in the near future the chamber process must be superseded for all acids which would require concentration in platinum stills. It is quite possible that the chamber process will continue to be used for many years to come, for the more dilute acids which require no concentration, but even so, the perfection of the contact process can be looked upon as little short of a revolution in this most important of the chemical industries.

J. L. H.

RELIEF SHIP FOR THE BRITISH ANTARCTIC EXPEDITION.

Sir Clements Markham, president of the Royal Geographical Society, has issued the following appeal to the Society's fellows:

It is with some reluctance that I appeal again to the fellows of the Society on behalf of the relief ship, which must leave England not later than July next to obtain news of, and render what assistance may be necessary to, the expedition on board the *Discovery*. I make this further appeal in the belief that the fellows as a body do not realize the situation, and entertain an erroneous impression as to how much is expected of each individually. I am assured that many, if not most, of the fellows of the Society feel that, unless they can each contribute a very considerable sum, it would be useless to do anything.

I am particularly anxious to disabuse the fellows of this impression; I assure them that we shall be glad to receive any contribution, however small. If each fellow of the Society made himself responsible for £2, we should be in a position to send off the relief ship fully furnished with all requirements. It is not necessary that each fellow should contribute £2 out of his own pocket; if he gives what he himself can afford, he would probably have no difficulty in obtaining the balance in small contributions from his friends.

Out of the 4,000 or more fellows of the Society, only 150 have contributed to the funds for the relief ship. I cannot help thinking that when those fellows who have not contributed realize this they will come to the help of the council, without hesitation, in the manner I have suggested, or in some way equally effective. The council has made itself responsible for the relief ship. The vessel, the *Morning,* has been purchased, and is now in the Thames undergoing the necessary alterations. When these are completed, the balance of the sum subscribed will be quite insufficient to furnish her with the necessary stores and to provide an adequate equipment of officers and crew.

In the hope of enabling the fellows to realize the situation and the Society's responsibility, I give the following extract from the last despatch from Captain Scott, written just before the *Discovery* left New Zealand to make her way through the ice to her destination:

> It is with great satisfaction that I learn that it is intended to send a relief ship. I had contemplated writing most urgently to you on this subject, knowing how absolutely our retreat would otherwise be cut off should any accident result in the loss of the *Discovery.* The conditions which surround the Antarctic lands with a belt of tempestuous ocean have always impressed me with the difference to those existing in high northern lands, and I have felt that, since our retreat by boats to any civilized spot is a practical impossibility, our movements, and the risks we could rightfully take, must be greatly limited, if the loss of the ship of necessity implied the loss of all on board.
>
> I see that every effort will be made to despatch the vessel which you have already purchased for the purpose. It will, therefore, be a great relief and satisfaction to me to leave Lyttelton, confident that such efforts will be successful and that a line of retreat is practically secured to us.

I feel sure that after this statement the fellows of the Society may be relied on to support the council in an undertaking absolutely essential to the complete success of the National Antarctic Expedition.

THE U. S. GEOLOGICAL SURVEY.

IN the U. S. Geological Survey the Geologic Branch is reorganized by the appointment of Mr. C. Willard Hayes to the position of geologist in charge of Geology to take effect March 1, 1902. Mr. Hayes has been connected with the survey since 1887 and has served with ability in various relations as assistant geologist, geologist, and since 1900 as geologist in charge of investigations of non-metalliferous economic deposits. He is now placed in administrative control of the geologic branch in order that the director may be relieved of executive details and the organization may be strengthened by the undivided attention of its head to carrying out the director's general policy. By this appointment Mr. Willis, who since 1897 as assistant in geology to the director has performed the administrative work of geology, is freed from that duty and will be at liberty to give more attention to the division of areal and stratigraphic geology, of which he has charge. In announcing these changes at a meeting of geologists in the office of the survey on February 20, the director called attention to the plan of organization of the geologic branch set forth in the Twenty-first Annual Report, pages 20 and 21, and more fully elaborated in the forthcoming Twenty-second Annual Report. The fundamental idea of the organization is that scientific direction and supervision may be and in most cases should be separated from administrative control. Specialists are placed in charge each one of investigations in a particular subject, Messrs. Becker, Chamberlin, Day, Emmons, Hayes, Stanton, Van Hise and Willis having been thus appointed, but their authority is in general limited to consideration and approval of the scientific aspects of the work. Administrative authority remained immediately with the director, and is now in a degree transferred to the geologist in charge of geology, Mr. Hayes.

SCIENTIFIC NOTES AND NEWS.

At the last meeting of the Rumford Committee of the American Academy of Arts and Sciences it was voted to appropriate the sum of $300 to Professor E. F. Nichols, of Dartmouth College, for the purchase of a spectrometer in furtherance of his research on resonance in connection with heat radiations.

Dr. Franz Boas, professor of anthropology in Columbia University and curator of anthropology in the American Museum of Natural History, has been elected an honorary member of the Anthropological Institute of Great Britain and Ireland.

Professor W. O. Atwater, of Wesleyan University, has gone to Havana for a conference on the dietary standards for the public institutions.

Professor Emile Boutroux, of the Sorbonne, has been elected Gifford lecturer in the University of Glasgow, in succession to the Master of Balliol, whose term has expired.

Principal E. H. Griffiths, of Cardiff University College, has been given the degree of Doctor of Science by Cambridge University.

Dr. M. E. Wadsworth, head of the department of mines and mining in Pennsylvania State College, has been elected geologist for the Pennsylvania State Board of Agriculture.

Mr. Henry L. Ward, one of the managers and vice-president of Ward's Natural Science Establishment, Rochester, N. Y., has been elected to the position of custodian and secretary of the Public Museum of Milwaukee, which position he will assume the latter part of March.

Professor E. Millosevich has been appointed director of the Astronomical Observatory at Rome as successor to Professor Tacchini, who retired recently.

The trustees of the Ohio State Academy of Science have made the following grants from the Emerson McMillin research fund: Professor Lynds Jones, Oberlin, Ohio, to enable him to complete his 'Catalogue of the Birds of Ohio,' $75; Professor J. S. Hine, Columbus, Ohio, to enable him to complete his work on the Tabanidæ, $50; Professor J. H. Schaffner and Fred. Tyler, to study and report on the ecology of Brush Lake, Champaign County, $50. No. 5 of the Special Papers of the Academy will soon be printed. It contains the results of investigations made with the aid of this fund.

Dr. Charles H. Gilbert, head of the department of zoology of Stanford University, will sail soon on the U. S. steamer *Albatross* on a six-months' scientific expedition to Hawaii, to continue the work conducted last year by Dr. David Starr Jordan and Dr. Oliver P. Jenkins. Dr. Gilbert will be accompanied by Professor C. C. Nutting, of the University of Iowa; Dr. John C. Snyder, instructor in zoology at Stanford, and Mr. Walter F. Fisher, a Stanford graduate from the same department.

The British Government appointed some time since a committee of experts, consisting of Lord Rayleigh, Sir J. Wolfe Barry and Professor Ewing, to ascertain how, if possible, the vibration of the Central London 'tube,' which is causing serious injury to property overhead, can be prevented. The committee recommends substituting carriages with motors underneath for the locomotives now used.

Dr. Adolf Meyer, director of the pathological Institute for the New York State Hospitals, gave an address entitled 'Conditions for Psychiatric Research,' before the Philadelphia Neurological Society on February 25. After the address a reception was tendered Dr. Meyer at the University Club.

Dr. L. O. Howard, entomologist of the U. S. Department of Agriculture, gave the annual public lecture before the Brown Chapter of the Society of the Sigma Xi on Wednesday evening, February 26, his subject being 'The Practical Applications of Entomological Science, with special reference to Shade Tree Insects.'

The death is announced of Mr. William Martindale, a prominent British pharmacist at the age of sixty-one years. He had been president of the Pharmaceutical Society and was for many years one of its board of examiners.

The death is also announced of Dr. Charles Stuart, a well-known English naturalist.

CIVIL service examinations will be held in New York City on March 15, for the following positions in the reorganized Pathological Institute: Associate in chemistry ($1,800); associate in clinical psychiatry ($1,200); associate in neuropathology ($1,800).

THE Prussian *Budget* for 1902 appropriates 20,000 Marks for further study of means of prevention and early diagnosis of typhoid fever; 10,000 Marks to the Committee for Cancer Research, and 53,000 Marks to be applied to the erection and maintenance of a cancer ward and laboratory in connection with the Charité Hospital at Berlin.

THE newly-organized American Electro-Chemical Society, which now numbers 294 members, will hold its first meeting at Philadelphia on April 3, 4 and 5.

THE general meeting of the American Philosophical Society, to which we have already called attention, will be held in the hall of the Society in Independent Square on April 3, 4 and 5. The morning sessions begin at 10:30 A. M. and the afternoon sessions at 2 P. M. Members intending to be present who have not yet notified the Committee on Arrangements to that effect are particularly requested to do so without delay. Luncheon will be served in the rooms of the Society. A reception will be given to the members by the president and managers of the department of archeology of the University of Pennsylvania at the Free Museum of Science and Art, Thirty-fourth and Spruce Streets, on Thursday evening, April 3, at 9 o'clock. The visiting members will be the guests of the resident members of the Society at dinner on Friday evening, April 4. A considerable number of important papers have been promised, a list of which will be published later in this journal.

UNDER the auspices of the department of zoology of Columbia University Dr. Jacques Loeb, professor of physiology and experimental biology at the University of Chicago, will give in March a course of lectures on 'The Dynamics of Living Matter.' The subjects are:

March 18, 'The General Chemical Character of Life Phenomena'; March 19, 'The General Physical Constitution of Living Matter'; March 20, 'Protoplasmic Motion, Muscular Contraction and Cell Division'; March 21, 'The Effects of the Galvanic Current upon Life Phenomena'; March 24, 'The Effects of Ions upon Various Life Phenomena'; March 25, 'The Effects of Light and Heliotropism'; March 26, 'Artificial Parthenogenesis and the Problem of Fertilization'; March 27, 'Regeneration and the Reversibility of the Process of Development.'

DR. ALEXANDER MACFARLANE will give at Lehigh University during March a course of lectures on British mathematicians of the nineteenth century, the dates and subjects being as follows:

March 14, 5 P.M., 'James Clerk Maxwell'; March 15, 11:30 A.M., 'Henry John Stephen Smith'; March 18, 5 P.M., 'William John Macquorn Rankin'; March 21, 5 P.M., 'James Joseph Sylvester'; March 22, 11:30 A.M., 'Peter Guthrie Tait'; March 25, 5 P.M., 'William Thomson, first Lord Kelvin.'

A COURSE of nine lectures upon 'Science and Travel' has been arranged by the Field Columbian Museum, Chicago, for Saturday afternoons in March and April at 3 o'clock. The lectures will be illustrated by stereopticon views. The subjects, dates and lectures are:

March 1.—'Texas Petroleum': Dr. WILLIAM B. PHILLIPS, professor of field and economic geology, University of Texas, and director of the university mineral survey.

March 8.—'The Sun Dance of the Cheyenne and the Arapaho': Dr. GEORGE A. DORSEY, curator of anthropology, Field Columbian Museum.

March 15.—'The Northern Rocky Mountains': Dr. STUART WELLER, assistant professor of paleontologic geology, University of Chicago.

March 22.—'Geological Field Work in the Iron and Copper Districts of the Lake Superior Region': Professor U. S. GRANT, Northwestern University, Evanston, Illinois.

March 29.—'Birds and their Nests': Dr. JAMES ROLLIN SLONAKER, University of Chicago.

April 5.—'Insects of Southern Peru and Bolivia': Mr. WILLIAM J. GERHARD, assistant curator, Division of Entomology, Field Columbian Museum.

April 12.—'Interpretation of Some Features of Landscape': Professor CONWAY MACMILLAN, University of Minnesota, Minneapolis.

April 19.—'Recent Explorations in Prehistoric Hopi Ruins, Arizona' (Stanley McCormick Expedition): Mr. C. L. OWEN, assistant curator, Division of Archeology, Field Columbian Museum.

April 26.—'The Crow Indians of Montana, A Western Plains Tribe': Mr. S. C. Sims, assistant curator, Division of Ethnology, Field Columbian Museum.

We learn from the London *Times* that the Government of India, which some time since selected an officer of the Forest Department to study the insects injurious to forests, more recently appointed an inspector-general of agriculture. It is reported now to be considering a further important step in the same direction, in the shape of the establishment of a scientific board to cooperate with the inspector-general. Probably it would consist of an economic botanist, entomologist, geologist and chemist. Agriculture is by far the greatest of Indian industries. The institution of a staff of trained inquirers to bring the light of Western science to battle with the legion of its chief enemies—drought, insect pests, and obstinate human ignorance—would be in entire accordance with the enlightened spirit of Lord Curzon's administration.

Professor M. Foster, secretary of the Royal Society, has addressed a letter to the London *Times* explaining the relation of the Royal Society to the proposed British Academy. He says: A committee of the Society was appointed to consider various suggestions which had been made to the Society as to the representation of philosophico-historical studies in an 'academy,' and to state 'the various reasons which may be urged for and against' the several suggestions. It is quite incorrect to speak of the eminent persons in question as 'applicants' for membership, or of the committee as appointed to consider whether the Society could recognize their claims, or should extend their charters in order so to do, though the committee did incidentally inquire into the powers given to the Society by the charters, and came to the conclusion that the above-mentioned studies could be included in the work of the Society. The suggestions were four in number—one proposing the creation of an independent organization and three proposing the promotion of these studies within the Royal Society itself in three different ways. The committee in its report made no recommendations; it simply 'stated the reasons for and against.' The council consulted the whole body of fellows at a special meeting, and subsequently passed a resolution, the meaning of which was that it approved of the first suggestion.

The British Meteorological Council has presented a report to the Royal Society which has been issued as a government blue book. The work of the office is summarized under the following heads: (1) Ocean Meteorology—the collection, tabulation and discussion of meteorological *data* for all parts of the ocean traversed by British ships. The preparation and issue of charts or other publications exhibiting the results obtained from the discussion of the observations. The issue of meteorological instruments for use on board the ships of the Royal Navy, and for observers belonging to the merchant service, with which is associated the supply of instruments to the telegraphic reporting stations, etc. (2) Weather Telegraphy—the collection of observations transmitted by telegraph three times in each day from selected stations in the British Isles (chiefly on the coasts) and on the continent of Europe, the preparation of a daily report embodying the observations and of forecasts of weather based upon them, and the issue of warnings to ports on the coasts of the United Kingdom whenever there are indications of the approach of severe storms. (3) Climatology—the collection of information of various kinds from observatories and other land stations in the British Isles and from a few stations in British possessions or in foreign countries with the view of extending the accurate knowledge of the meteorological conditions obtaining in the various districts in which the observations are made, and of the changes to which they are subject. (4) Library—for the collection and preservation of weather maps and other publications issued by the colonies and dependencies of the British Empire and by foreign countries, so that they may be available for consultation by those requiring information as to the weather in various parts of the globe. (5) Miscellaneous investigations. (6) Publications. (7) Finance.

Nature states that an astronomical observatory has been erected and equipped by the Bengal Government at the Presidency College, Calcutta, and was recently opened. The idea of providing means for the instruction of Indian youths in practical astronomy was conceived about five years ago, when the Maharaja of Tipperah presented to the Presidency College an equatorial telescope by Grubb, 4½-inch aperture. On Dr. J. C. Bose's representation, the Government of Bengal agreed to provide a building suitable for observations. But it was not done until after the eclipse of January, 1898, when the professional and amateur astronomers who visited India caused active interest to be taken in building the observatory. From an article in the *Pioneer Mail* it appears that the chief instrument of the observatory is a 7-inch equatorial by Sir Howard Grubb, with an electrically controlled driving clock and with electric lights for all the graduated circles. The telescope will generally be used for eye observations, but the object-glass may be adapted to photography, and the mounting of the telescope is of a strength that will admit of its being used for spectroscopic examination of the sun or the brighter stars.

AT a meeting of the members of the Royal Institution on February 3 thanks were returned to Sir Frederick Bramwell, for his donation of £100, and to Mr. Frank McClean, for his donation of £50 to the fund for the promotion of experimental research at low temperatures. It was announced that the following valuable relics of Michael Faraday, bequeathed to the institution by the late Mr. Thomas J. F. Deacon, had been received: Medals of silver and bronze (numbering 20 in all), and including the Fuller medal of 1828, two Copley medals of 1832 and 1838, two Newton medals of the Royal Society, 1833 and 1838, and the Rumford medal of 1846; and two foreign Orders, contained in a small mahogany box; a book of portraits and autographs, including orginal letters from the Prince of Wales and Prince Alfred, Louis Napoleon, Humphry Davy, Thomas Young, Humboldt, John Dalton, Whewell, Mary Somerville and many others; a daguerrotype of a consultation of Faraday with Professor Daniell; a drawing in colors of the laboratory of the Royal Institution, and a manuscript book entitled 'A Class Book for the Reception of Mental Exercises instituted July, 1818,' containing contributions by Faraday.

THE following sets of scientific books were recently sold at auction in London: *The Alpine Journal,* from the commencement in 1863 to November, 1901, £29 10s.; M. C. Cooke, 'Illustrations of British Fungi,' and supplement, 1881–91, with upwards of 700 colored plates, £23; the *Quarterly Journal of the Geological Society of London,* from the commencement in 1845 to August, 1901, £16; Sowerby's 'British Botany,' 1863, etc., £33; the publications of the Palæontographical Society, 1848–97, £17 15s.; H. G. L. Reichenbach, 'Icones Floræ Germanicæ et Helvetiæ,' etc., 1850–99, 23 volumes with upwards of 2,000 colored plates, £63 10s.

WE learn from the London *Times* that under the presidency of Dr. Morris, the Imperial Commissioner of Agriculture, the fourth West Indian Agricultural Conference was held at Barbados on January 4 and 6 last, there being a large gathering of the representatives of the botanical, chemical, and educational departments, and of the chief agricultural societies in the West Indies. The proceedings were opened by Sir Frederic Hodgson, the governor of Barbados, in an address of welcome. In his presidential address Dr. Morris passed in review the various industries of the islands, from sugar to bee-keeping and onion-growing. With regard to the question of central factories he expressed the hope that in some of the smaller sugar islands it had approached a stage when the details may be submitted to the consideration of the planting community. In Barbados the opinion is not unanimous that central factories would materially improve the condition of all classes of the community. It is only proposed to introduce factories gradually, but so long as nothing is done it is difficult to look forward with any degree of comfort to the future of the sugar industry of the island. Papers on various subjects were read and discussed, sugar, naturally, taking the foremost place. There were communications on sugar-cane experiments in Barbados, Antigua, St. Kitts, Trinidad and British Guiana. In Guiana an important feature has been the trials of canes on an estate scale, in addition to the necessary small plots. It is fully realized by the officials of the Imperial Agricultural Department that a strenuous attempt must be made to raise the general standard of intelligence amongst all classes; and it is in contemplation shortly to commence the publication of a fortnightly paper, the *Agricultural News*, containing hints and advice in regard to all points of interest in the islands.

UNIVERSITY AND EDUCATIONAL NEWS.

It is announced that Mr. James Stillman, of New York, has given $100,000 for the establishment of a chair of anatomy in the Harvard Medical School.

The University of Wooster, Wooster, O., successfully completed on February 21 a campaign to raise $140,000 in order to secure two large conditional gifts, $100,000 by Mr. Andrew Carnegie and $50,000 by Mr. L. H. Severance, of Cleveland. In place of the building which was destroyed by fire on December 11, there will be erected a main building containing lecture rooms, a building for chemistry and physics, a building for biology and geology, an academy building and a heating plant.

It is proposed to establish in New York City a branch of the Catholic University of America, to be known as the Department of Pedagogy.

Mr. John D. Rockefeller has given $5,000 to Washington and Lee University, thus completing the fund of $100,000 for a memorial to the late President William L. Wilson, in the form of an endowment for the chair of economics and political science.

The trustees of the University of Pennsylvania have awarded the contract for the construction of the new Medical Laboratories. In the extent of the plan and in the cost of this addition to the facilities of the University, it is the most important agreement ever entered into by the corporation. Since the study of the subject was first begun, the scope of the purposes to be attained has so widened that from the original projected cost of two hundred thousand dollars, three years ago, the cost of the completed undertaking now entered upon will be about six hundred thousand dollars. The study of the plans has covered all the scientific medical laboratories both in Europe and in this country; and the faculty of medicine feel, and the members of the medical committee of the trustees feel, that the result as submitted by the architects, Messrs. Cope & Stewardson, will repay all the attention and study and pains which have been taken. The building will be wholly fire-proof, and its extent may be understood when it is known that its front on Hamilton Walk is three hundred and forty feet, and the depth of its western wing, one hundred and ninety feet. Provision in respect of north light and of quiet and of freedom from dust has been made for original work in all three of the laboratories included in the building.

Professor Josiah Royce, professor of philosophy at Harvard University, and Professor J. Mark Baldwin, professor of psychology at Princeton University, will lecture before the summer school of the University of California during July.

At Cambridge University Professor Tilden, F.R.S., has been appointed an elector to the chair of chemistry; Lord Rayleigh, F.R.S., an elector to the chairs of chemistry and of mechanism; Dr. Hill, to the anatomy chair; Mr. F. Darwin, F.R.S., to the botany chair; Dr. Hinde, F.R.S., to the geology chair (Woodwardian); Sir G. G. Stokes, F.R.S., to the Jacksonian and Cavendish chairs; Dr. D. MacAlister, to the Downing chair of medicine; Dr. Hugo Müller, F.R.S., to the chair of mineralogy; Professor E. Ray Lankester, F.R.S., to the chair of zoology and comparative anatomy; Professor McKendrick, F.R.S., to the chair of physiology; Lord Lister, F.R.S., to the chair of pathology; and Professor Marshall Ward, F.R.S., to the chair of agriculture.

Dr. Franz Wilhelm Neger, curator in the Botanical Museum at Munich, has been called to a professorship in the School of Forestry at Eisenach.

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, MARCH 14, 1902.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE SOCIETY FOR PLANT MORPHOLOGY AND PHYSIOLOGY.

THE fifth regular annual meeting of this Society was held at Columbia University, New York City, December 31, 1901, and January 1, 1902, under the presidency of Dr. Erwin F. Smith. There was a good attendance of members, and the meeting was in all ways successful. Friendly greetings were exchanged by telegraph with the botanists in session at Chicago. Some business of general interest was transacted, of which a full account will be found below. This included action upon the report on the *Botanisches Centralblatt* and the Association Internationale des Botanistes, the nomination of American members of the executive committee of the Association Internationale, and the report on the College Entrance Option in Botany. The following new members were elected: Miss Margaret Ferguson, Wellesley; Messrs. Ernst A. Bessey, Washington; T. E. Hazen, St. Johnsbury, Vt.; A. S. Hitchcock, Washington; C. F. Hottes, Urbana, Ill.; E. C. Jeffrey, Toronto; and R. H. True, Washington. The following officers were elected for the ensuing year: President, Professor Volney M. Spalding, University of Michigan; Vice-President, Professor Byron D. Halsted, Rutgers College; Secretary-Treasurer, Professor W. F. Ganong, Smith College. The Society will meet next year with the other societies at Washington.

On the afternoon of January 1 the Society adjourned to the New York Botanical Garden at Bronx Park, where the museums, laboratories and collections of living plants were shown by members of the Garden staff, and Professor MacDougal exhibited some new appliances developed in connection with his physiological work.

Among the enjoyable social features of the meeting were the luncheon given to the Society and its guests at the Teachers College by Professor Lloyd, and the very pleasant informal dinner of the botanists on Wednesday evening. The hospitality of the New York botanists to the members of the Society and their guests was most cordial, and contributed greatly to the pleasure and profit of the meeting. A group photograph of the Society was taken, resulting in an excellent picture, concerning the cost and other particulars of which information will be furnished by the secretary.

The address of the retiring president, Dr. Erwin F. Smith, was delivered at the dinner. It dealt with 'Plant Pathology, a Retroprospect and Prospect.' It will soon appear in full in Science.

The following papers and reports were presented and discussed. Owing to the crowded condition of the program at the preceding meetings, papers were accepted this year from members and nominees to membership only. The abstracts are prepared by the authors.

Artificial Changes affecting the Vegetation of the Huron River: Professor V. M. Spalding, University of Michigan.

In the course of a botanical survey of the Huron river and valley it has been found that artificial changes induced by the erection and breaking down of dams have been followed by rapid and extensive readjustment and adaptation. Changes of water level and rapidity of current are responsible for some of the most striking phenomena. Several species, among them *Polygonum emersum* and *Solanum Dulcamara,* exhibit remarkable plasticity, and their structural changes are such as enable them to play the part of aquatics or of land plants as the raising or lowering of the water level may require. Charts are being constructed to show the present distribution of the various plant societies of the river and valley in the vicinity of Ann Arbor.

A Floating Tropical Botanical Laboratory: Dr. John W. Harshberger, University of Pennsylvania. (Illustrated.)

The West Indies, lying in close proximity to the United States, are easily accessible to American botanists. By means of lantern slides, a few of the possible lines of research work, suggested on a visit to the Bahamas, Haiti and Jamaica during the summer of 1901, were illustrated. It was suggested that an investigation of the mature bending of the trunk of the coco-nut palm, of the pollination of the West Indian grown figs (*Ficus*), of the ecologic relationship of the plants of the strand, of the xerophytic and mesophytic forests, might be undertaken with profit. As many of the islands have an irregular coast line, are somewhat inaccessible, and as the inhabitants of Haiti look with suspicion upon strangers, it was thought advisable in investigating the flora of the various islands to visit them by means of a steamer fitted up as a tropical research laboratory. The steamers, Norwegian built (such as the *Belvernon* and *Mt. Vernon* of the Cameron Line), cut away fore and aft, were thought best adapted for the purpose.

The Physiology of Sea Water: Dr. Rodney H. True, Department of Agriculture.

The studies reported were made at

Wood's Holl, Mass., during portions of the last three summers. The plant most used was *Cladophora gracilis*. This alga was able to survive temporarily in a cane-sugar solution containing 1.2 gram molecules per liter of solution without apparent injury, and carried on its functions with seeming regularity. A greater or less proportion of the cells lived in concentrations between 0.3 grm. mol. and 1.6 grm. mol., but at the extremes unbalanced osmotic forces wrought injury to the younger cells. The plants were fatally affected within an hour by solutions of sodium chlorid in all concentrations, and in a solution isotonic with sea water were unable to respond to plasmolytic tests after about one-half hour. A progressive synthesis of artificial sea water, containing those substances present in a quantity equal to five thousandths of one per cent., was made. Death in a solution containing the proper amount of sodium chlorid took place in about a half-hour. When to this magnesium salts were added, no marked change in the period of survival was seen. The addition of the trace of calcium sulfate required extended the time of survival to about two hours. On the further addition of the potassium compounds, the plants lived for about twenty-four hours. Although isotonic with natural sea water, this artificial mixture was less saline to the taste than the former. On adding further sodium chlorid (about three-fourths per cent.) until equal salinity to the taste was obtained, the artificial solution was found to be capable of supporting an apparently normal existence in the alga for eight days. Evidence that cannot be summarized here was presented in support of the view that not only the actual amount of substances dissolved is concerned in the physiological behavior of sea water, but that the form in which these things there exist is important. Further work is in progress.

On the Teaching of Plant Physiology to Large Elementary Classes: Professor W. F. GANONG, Smith College.

The author called attention to the fact that the advance of science depends not only upon the acquisition of new knowledge and its correct interpretation, but also upon its utilization, of which one phase is its application in education. Plant physiology is rapidly rising in educational favor, but a chief obstacle to its more rapid advance is the difficulty of teaching it to large classes by proper laboratory methods. It was pointed out that many of the practical difficulties are disappearing with the improvement in methods and appliances, and ultimately the subject will be taught through individual experimentation. This is not yet practicable in large elementary classes, and at present students must be taught *en masse*. After trial of various plans the author had attained fair success by selecting the ten or twelve most fundamental experiments and setting them up, with full explanations, before the class, requiring the students individually to make records and finally to present reports upon them. The details of the management of the plan on which its success largely depends can not be repeated here, but the paper is soon to be published in *School Science*.

Discussion on the Most Profitable Relation of the American Botanical Societies to one another.

The opinions brought out by this discussion agreed very closely with those expressed by the speakers before the American Society of Naturalists at Chicago on January 1, as reported in this journal for February 14. One speaker urged a closer union of the various societies with the American Association, while another advocated the merits of a double system, in which regional societies, meeting regularly in the principal centers within natural geographical districts, would combine with the American Association whenever the latter meets within their territory, the American Association thus forming a bond between the various regional societies.

Report of the Committee on the Botanisches Centralblatt, presented by the Chairman, Professor W. G. Farlow, Harvard University.

Printed copies of the report were distributed to those present. It showed a completely successful result of the committee's work. A full account of this report and its bearings will be given elsewhere in this journal, so that for the present it is enough to say that it describes the continuance of the correspondence with the proprietors of the *Botanisches Centralblatt* authorized by the Society last year, the purchase of the *Centralblatt* by the Association Internationale des Botanistes, and the selection of the seven American editors of the journal. The committee having completed its work was discharged with the thanks of the Society. Professor Farlow explained further the present status of the *Centralblatt* as the organ of the Association Internationale, and the business features of the arrangement. Membership in the Association is open to any one interested in botany, on payment of the annual subscription of 25 shillings, and all members will receive the *Centralblatt* free. To meet the purchase price of the *Centralblatt* one hundred bonds have been issued of the value of 250 florins each ($100.68), subscription to one or more of which makes one a foundation member of the Association. These bonds bear interest at the rate of 2½ per cent. and are to be redeemed from the profits of the *Centralblatt*. Very few have yet been taken in this country, and it is desirable, in order that this country may do its share in this important matter, that more should be taken here. The *Centralblatt* promises to be a strong journal of reviews, indispensable to every botanist, and it now has the support of the leading botanists of the world. In the discussion which followed, it was pointed out that American members of the Association Internationale would soon be called upon to vote for two American members of the general executive committee of the Association. There appears to be no body of botanists with authority to make nominations of such members, although in the absence of nominations the votes are likely to be very scattering or even not cast at all. It was then suggested that, in view of the fact that this Society had managed the correspondence with the proprietors of the *Centralblatt* and had aided the Association Internationale to choose American editors, etc., it might not be inappropriate for the Society also to suggest nominations of American members of the executive committee. Accordingly the Society voted to thus suggest the nomination of Professors W. G. Farlow and C. E. Bessey. Professor Farlow stated that he would be unable to serve on the committee, and accordingly Professor W. F. Ganong was nominated instead. It was announced that any further information about the subject, copies of the report of the committee, or of the blank forms of application for membership in the Association or for subscription to bonds, could be obtained from Professor Trelease, Missouri Botanical Garden, St. Louis, Mo., chairman of the American Board, or from the secretary of the Society.

On the Teaching of Vegetable Pathology: Dr. Hermann von Schrenk, Shaw School of Botany.

The speaker discussed the scope of vegetable pathology and urged the necessity of recognizing the plant as a living organism. For a course of vegetable pathology, a thorough knowledge of physiology, general chemistry (preferably also organic chemistry), physics, general morphology of higher plants, French and German ought to be required. He outlined a course in pathology beginning with the study of the influence of environmental conditions on the plant cell, followed by actual experimental work with bacterial and fungous diseases. Emphasis was laid upon the fact that the plant should be considered first and foremost, and that the student should work with this himself.

The Destruction of Cell Walls by Bacteria: Dr. ERWIN F. SMITH, Department of Agriculture.

Lantern slides were exhibited showing all stages in the destruction of the inner tissues of the turnip due to the parasitism of *Pseudomonas campestris.* All were made from one plant which was inoculated on the blades of the leaves by means of needle pricks, using a pure culture of this bacterium. The disease appeared on the leaves only after a number of days. There was a progressive downward movement of the disease. The plant was removed from the soil on the fifty-second day after inoculation, at which time most of the leaves were shriveled, but the root was white and entirely sound externally. Sections of the root showed the bacteria to be very abundant in the inner parts. A careful microscopic examination made at the time did not reveal the presence of any fungi or animal parasites in the tissue. Cultures made from the interior of this root yielded only *Pseudomonas campestris.* Portions of the root were fixed in strong alcohol and subsequently infiltrated with paraffin, cut on the microtome with a very sharp knife, and fastened to slides with water containing one-half per cent. gelatin, freshly prepared. The paraffin was subsequently dissolved out with turpentine, the sections stained in carbol-fuchsin, washed in water containing 50 per cent. alcohol, passed through graded alcohols, dehydrated in absolute alcohol, passed into xylol and finally mounted in Canada balsam. A study of serial sections with the best microscopic appliances has failed to reveal the presence of any fungi in the sections. The parts which are attacked are only the inner parts of the root (vessels and parenchyma). Many of the bundles are filled with the short bacterium, and cavities in the parenchyma are found around some of these bundles. The fixing and subsequent treatment of the sections allow the study of the organism *in situ.* The bacterial masses are not torn or displaced by the knife, and an examination of these slides shows all stages in the solution of the cell walls, from single cells or vessels occupied by the bacteria, to cavities occupying the place formerly occupied by hundreds of cells and filled with the bacteria and the remnants of the cell walls. The cells are crowded apart by the growth of the bacteria, and the middle lamella first disappears, but the cell walls proper also become vague in outline and finally disappear.

Observations on the Bacterial Rot of the Calla Lily: Dr. C. O. TOWNSEND, Department of Agriculture.

This is a soft brown rot, with offensive odor, that usually attacks the bulbs but may appear on the roots or leaves. It has been observed to destroy the calla plants in entire houses in the vicinity of Washington. As a rule, the bulb shows the disease most frequently near the top, but it often happens that the attack is made below the surface of the ground, in which case the bulb is commonly almost entirely destroyed before the leaves indicate that the plant is diseased. If proper conditions prevail, the disease progresses rapidly and the diseased tissue is broken down. Agar plate cultures, made with care from the advancing margin of the diseased area, give only bacteria and generally pure cultures of a rod-shaped motile Schizomycete. Neither fungi nor burrowing insects are present. The colonies appear in the agar plates in from twenty-four to thirty-six hours. The surface colonies grow rapidly, are nearly round, slightly convex, having a milky color, shining surface and entire margin. The imbedded colonies remain much smaller, are mostly spindle-shaped and have a brownish tinge. The organism grows rapidly on nutrient, slant agar, and on steamed potato, carrot, parsnip, salsify, beet and onion. It does not discolor the medium upon which it grows; it develops slowly in alkaline gelatin; the stab cultures are beaded in form, and the gelatin is not liquified. Milk is coagulated rather rapidly; blue litmus milk is changed to red and eventually faded to white. Nitrates are reduced to nitrites. The organism grows in the closed end of fermentation tubes containing peptonized beef bouillon with 5 per cent. grape sugar, but without formation of gas. Diseased plants have been treated with lime, sulfur and dilute formaline, with some success in controlling the disease, but the best treatment found thus far consists in changing the soil in the calla bed or in growing the plants in pots, and in the proper management of the greenhouses.

A Disease of the American Ash: Dr. Hermann von Schrenk, Shaw School of Botany.

A disease of *Fraxinus Americana* caused by *Polyporus fraxineus* was described. Attention was called to the large per cent. of living trees affected with this disease in localities where the ash is present in large numbers.

Vegetative Reproduction in Leptolejeunea: Professor A. W. Evans, Yale University.

Certain species of the epiphyllous genus *Leptolejeunea* reproduce themselves largely by means of leafy propagula, which represent modified branches. This type of vegetative reproduction, although known in several mosses, has not before been recorded for the hepatics. The first leaves and under leaves of the propagula show curious modifications, and the most remarkable of these are found in the underleaves, which develop disc-shaped suckers instead of the usual clusters of rhizoids. By means of these suckers, the propagula are able to attach themselves quickly to the smooth leaf-surface upon which they grow.

Observations on Pterygophora: Professor Conway MacMillan, University of Minnesota. This paper will be published in full in *Minnesota Botanical Studies.*

Pterygophora grows much larger in the Straits of Fuca than reported in systematic works upon the kelps. It has been found with stipe three meters in length and a decimeter in thickness. Secondary thickening, in *Lessonia* apparently limited to the stipe, takes place in *Pterygophora* in both hapteres and stipe, producing rings of growth in each of these organs. Secondary thickening in the haptere differs from that in the stipe. In the former the ringed appearance is principally due to succession of cell layers differing in contents; in the latter the ringed appearance is due to succession of cell layers in which the elements are of different size and shape. A cross section through the growth-ring in the stipe of *Pterygophora* recalls similar sections through the stem of Gymnosperms. The substance which by its varying abundance in successive cell layers gives rise to the ringed appearance in cross sections of old hapteres is related to that which has been called fucosan and appears to be polysaccharid in character. Pits, in the strengthening tissue and tissue of growth-rings of the stipe, are abundant upon the concentric faces of the tracheid-like elements, but are generally absent from the radial faces. Mucilage canals announced for this plant by Ruprecht are wanting. An abundant formation of polysaccharids goes on in old pinnæ and hapteres. *Pterygophora* differs strongly in its anatomical structure from *Lessonia*. The secondary thickening differs anatomically from that of other kelps studied. A series of young plants, from 2 cm. in length, shows that the midrib is basally developed in the principal lamina and that it is not present in the younger stages. In this respect *Pterygophora* strongly differs from *Alaria*. The classification of *Pterygophora* in the vicinity of *Alaria* is of somewhat doubtful value. It appears rather to be a genus of Laminarieæ and may be related with such a form as *Laminaria radicosa* Kjellman.

Germination of Basidiomycetous Spores: Dr. MARGARET E. FERGUSON, Wellesley College.

This investigation was undertaken to determine, more definitely than is known at present, the conditions of germination in the Basidiomycetes, particularly in *Agaricus campestris*. Twelve species out of the twenty-six studied in preliminary tests yielded high percentages of germination in various media, and four species gave fifty per cent. germination or less. The spores of eleven species germinated in distilled water, but the percentages of germination were invariably lower than when an external food supply was present. The effect, on the germination of the spores of *Agaricus campestris,* of extremes of temperature, alkalies, acids, and organic substances was tested. The spores were also subjected to the action of an artificial digestive fluid. The percentages of germination obtained in these experiments with *Agaricus campestris* varied from 0 to 25. Almost perfect germination of the spores of this species was, however, obtained in a large number of cultures and in various media; but a high percentage of germination never occurred except in cultures containing the growing mycelium of *Agaricus campestris*. The germinated spores were frequently transferred to test-tubes containing bean stems and other solid substrata, and in many instances abundant mycelium was produced. A full report of these studies, which were undertaken at the suggestion of Professor B. M. Duggar, is now in the hands of the publishers and will appear shortly.

Behavior of Mutilated Seedlings: Professor BYRON D. HALSTED, Rutgers College. (By title.)

The particular form of mutilation of seedlings here considered is that of the removing of the plumule. In radish seedlings the first change noticed was the deeper green of the cotyledons, followed by a remarkable elongation of the petioles. The cotyledons became thicker than in those of the normal plants, due to increase in size of cells, and filled with starch, while the roots grew to considerable size. In the morning glory a similar behavior of the cotyledons was observed, while the hypocotyls became enlarged and served as a repository for the large accumulation of starch. In the Hubbard squash the cotyledons of the deplumuled plants remained close to the earth and grew to four or more inches in length, and held green for over four months. The egg-plant as a type of a slow-growing seedling produced rigid upright cotyledons that became quite fleshy and remained alive for many months. The sunflower illustrates a type in which the hypocotyl elongates greatly until it is sometimes over nine inches in length, with the primitive structure retained. In other words, the ring of wood is not developed as in the normal plants. These experiments illustrate how an organ normally designed to store food for the developing seedling may persist in an emergency and take on a greatly increased size for that purpose. The petiole may assume a direction in connection with its enlargement that will aid the blade in its work of photosynthesis. Along with these changes in the seed leaves there may be others in surrounding parts, particularly the hypocotyl which becomes thickened remarkably and green in the morning glory and greatly elongated but slender in the sunflower. In the radish a place for any surplus growth still remains, for the root is naturally destined to be fleshy and the hypocotyl is not modified.

Notes on New Species of Lichens collected by the Harriman Expedition: Professor Clara E. Cummings, Wellesley College.

The list, soon to be published, contains an enumeration not merely of the species collected by the members of the Harriman expedition, but also of various other collections, notably that made by Professor Setchell in Alaska the same year. The total number of species and varieties listed is 219. Of these 97 species are new to Alaska, three of which are new to America and three others new to science. The three new species were referred provisionally to the genera *Verrucaria, Endocarpon* and *Pertusaria.* The Verrucaria was said to be characterized by an unusual development of the thallus. Three points of difference from the typical *Endocarpon* were noted, namely the distribution of the gonidia throughout the tissue of the thallus, the numerous perforations in the mature prothallus and the projection of the apothecia beyond both surfaces of the thallus. In further discussion the possibility was suggested that new genera might perhaps be established for the so-called *Verrucaria* and *Endocarpon.*

What is the Archesporium? Professor F. E. Lloyd, Columbia University.

It is proposed to limit the use of the term 'archesporium' to the mass of cells which, by tetrad divisions, gives rise to spores. The cells heretofore so designated have diverse origins and no peculiar morphological features, and are distinguishable only by their denser cytoplasmic contents. They are vegetative cells which are set aside when an extensive archesporium is necessary. It is only when the constituent cells enter the heterotypic mitoses that their peculiar character is without doubt evident. In parthenogenetically reproduced plants where true tetrad division in this sense lapses, the archesporium is determined on comparative grounds.

The Continuity of Protoplasm: Dr. Henry Kraemer, Philadelphia College of Pharmacy. (By title.)

The earlier studies of the author upon the structure of starch grains showed under certain conditions the presence of radiating feather-like clefts, which he concluded represented channels through which liquids are distributed throughout the grain. Studies with similar reagents upon cell walls seem to imply a similar nature for many markings which have commonly been explained as passages for permitting the continuity of protoplasm from cell to cell. He calls attention to references to the use of sulphuric acid in the study of continuity of protoplasm, and the objections to its employment for this purpose. The studies are being continued.

The Embryology and Germination of the Genus Peperomia: Professor Duncan S. Johnson, Johns Hopkins University.

The ripe seed of this genus is about .5 mm. long; the globular, fifteen-celled embryo only .04 mm. and the surrounding endosperm .1 mm. in diameter. In germination the endosperm bursts out of the seedcoat at the tip but continues, as a jacket two cells in thickness, to enclose the embryo till the latter, after reaching a size of .15 mm. as a globular, undifferentiated mass of cells, at length develops two cotyledons and a root, and the latter bursts through the endosperm and bends down to anchor in the soil. From the beginning of its development to the time when it drops, with the exhausted seed, from the tips of the highly elevated cotyledons the endosperm seems never to serve for the storage of food material, but always as a digesting and absorbing organ for dissolving and passing on to the embryo the starch with which the abundant perisperm is filled. This seems to be the sole function of the endosperm also in many other genera, especially those with abundant perisperm, *e. g.*, *Saururus, Heckeria, Dianthus* and *Cerastium.*

Report of the Committee on the Standard College Entrance Option in Botany: Presented by the Chairman, Professor W. F. GANONG, Smith College.

The report stated that the option had been formulated by the committee, had been printed and distributed to members in April and had been widely circulated among prominent teachers. Notes calling attention to it had been inserted in SCIENCE and in *School Science* and had caused a demand which exhausted the edition of 200 copies. Taking into consideration the criticisms and suggestions received, the Committee (reduced to the chairman and Professor Lloyd by the withdrawal of Professor Atkinson) prepared a revised edition which was printed in June and distributed in October. As a whole, the replies to the request of the Committee for suggestions, etc., indicated a surprisingly wide approval of the features of the option recommended by the Committee. The adverse criticisms were practically only three. First, it was thought by some too difficult for a year of high school study. In answer to this it was stated that it was the intention to make it fully as hard as a year of any other subject whatsoever taught in the high schools. The time is past when botany should be content to occupy a humble corner in the high school curriculum. It may be offered or not offered, but if offered at all it must be upon a plane equal to that of any other subject whatever. Second, it was objected, though not widely, that it laid too much stress upon ecology, which was thought not to be a proper high school study. The general consensus of opinion, however, seems to favor some ecology in the high school course, though it should be only of the most concrete and definite sort, and it is this kind of ecology the Committee has endeavored to emphasize. Third, it has been held that the part dealing with the types of plants and groups should not proceed primarily, as the Committee recommends, from the point of view of natural history but from that of morphology. In answer to this the Committee points out that the one does not exclude the other, and that in order that the course may be equally available for the education of those who go no farther and for those who continue into higher courses, it seems best to approach the subject from that point of view which will have the most meaning for the average high school student, and which will yield him the knowledge of most pleasure and profit to him in after life. In the opinion of the Committee such a point of view is rather that of natural history than of comparative morphology, and the special comparative morphology of the groups can best be taken up in second courses by those who go on. It was reported that the option had been formally adopted by the College Entrance Examination Board, and would shortly be published in one of their documents. This, together with the widely favorable criticism it has received, indicates that it will probably be widely adopted. The Committee recommended that a standing committee of two be appointed to take the further interests of the option in charge, to keep it in touch with educational progress, and readjust it to changing conditions; and that a new edition be prepared for distribution. The report was adopted, and as the committee, the former committee, Professors Ganong and Lloyd, was reappointed.

W. F. Ganong,
Secretary.

THIRD ANNUAL MEETING OF THE CORDILLERAN SECTION OF THE GEOLOGICAL SOCIETY OF AMERICA.

The Cordilleran Section of the Geological Society of America held its third annual meeting in the Academy of Sciences, San Francisco, on December 30 and 31, 1901. In the absence of the chairman, Professor W. C. Knight, of Wyoming, Mr. H. W. Turner was elected temporary chairman. The secretary reported the following rules as having been adopted by the Council of the Society at Denver, August 26, 1901:

1. *Officers.*—The officers of the Cordilleran Section shall be a Chairman and a Secretary. The latter shall also perform the duties of an accounting officer with reference to the expenses of meetings.

The officers of the Section shall be resident within the geographical limits of the Section. A President or Vice-President of the Society shall be, *ex officio*, Chairman of the Section whenever present at a meeting.

2. *Geographical Limits.*—For purposes of scientific fellowship and discussion the limits of the Section shall correspond with the limits of the general Society, and the meetings of the Section shall be open to all Fellows of the Society for presentation of papers, either in person or by proxy. For purposes of administration the membership of the Section shall be limited to those Fellows residing west of the 104th meridian.

3. *Membership.*—No person not a member of the Society may become a member of the Section. Members may invite contributions to the discussions at their meetings under the same rules as those applied to meetings of the Society.

4. *Date of Meetings.*—The meetings of the Section may be held at any time, subject to approval by the Council of the Society (Article 4 of Constitution). All notices and programs of meetings shall be sent to all Fellows of the Society.

5. *Expenses.*—The expenses of the Section, so far as they shall be paid from the general fund of the Society, shall be limited to the ordinary economical expenses of the meetings.

6. *Publications.*—All papers presented to the Section shall be available for publication in the *Bulletin* of the Geological Society of America under the rules governing publication by the Society.

The officers elected for the ensuing year were: H. W. Turner, of San Francisco, Chairman, and Andrew C. Lawson, of Berkeley, Secretary. An executive committee consisting of the chairman, secretary and Professor J. C. Merriam was appointed.

Resolutions were adopted expressive of the sense of loss sustained by the Section in the deaths of Professors Joseph Le Conte and E. W. Claypole.

The following papers were read and discussed partly in the Academy of Sciences and partly at the University of California, where the Section met after the opening session, for the purpose of viewing illustrative specimens and lantern slides:

An Instance of Variability in a Rock Magma: H. W. TURNER, San Francisco, Cal.

The instance referred to is the granolite area east of Sonora in Tuolumne County, California. This area is enclosed on three sides by the sedimentary rocks of the Calaveras formation, and on the east by a granite and gneiss series of older age, so that it is practically an enclosed area. The rock is designated, on the Sonora geological map of the United States Geological Survey, granodiorite, but it is not a typical example of that rock. It contains at most points some orthorhombic pyroxene. The rock varies from a granodiorite containing nearly 63 per cent. of silica to olivine gabbro containing about 43 per cent. of silica, there being all gradations between these extremes. The mass is intrusive in the Calaveras formation. The gabbro forms a hill in the interior of the area. The variation in mineral and chemical composition is not regarded as being due to absorption of material from the surrounding rocks, but to a differentiation during crystallization. On the west and south the Calaveras rocks contain much limestone, but the most basic facies of the rock, the olivine gabbro, is not near their contact. Moreover the limestone is not a magnesian limestone, and if we seek to explain the high lime content of the gabbro (14.27 per cent.) by an absorption of lime from the adjoining calcareous rocks, we are also brought to account for the high magnesia content (7.65 per cent.) of the gabbro from a similar source, and there are no magnesian rocks in the neighborhood outside of the granodiorite-gabbro mass, except small amounts of perknite or amphibole-pyroxene rock, and these are not, except at one point, in juxtaposition to the granodiorite-gabbro area. There perknites may indeed be themselves the extreme result of differentiation of the granodiorite. There are abundant dikes of diorite in the granodiorite, and pegmatite and quartz-tourmaline dikes or veins.

Triassic Reptilia from Northern California: JOHN C. MERRIAM, Berkeley, Cal.

Reptilian remains were first discovered in northern California in 1893, when Professor James Perrin Smith obtained two short series of vertebræ and two arch bones in the Triassic limestones. These specimens were described by the writer in 1895, under the name of *Shastasaurus,* and were thought to belong to a form closely related to the Ichthyosauria, though they did not appear to find a place in any known genus. During the summer season of 1901 a quantity of new material was obtained from the original locality. The collection includes considerable parts of five skeletons, also numerous loose limb-bones, vertebræ, ribs, etc. Nearly all of the specimens belong to the genus *Shastasaurus,* of which there are several well-characterized species. Two nearly complete series of dorsal and cervical vertebræ show *Shastasaurus* to be characterized by possessing single-headed ribs on all of the vertebræ in this region excepting the anterior 8–9. In the cervicals the parapophysis is relatively small and in the anterior dorsal region it disappears entirely. As far back as the middle dorsals the articular surface of the diapophysis is confluent with that for the reception of the upper arches. The anterior and posterior limbs have not been found together, but are known from species having the same type of vertebræ and ribs. The anterior limb is ichthyosaurian in type, but the transverse diameter of the humerus is much greater than the longitudinal. The radius and ulna are very short and are separated by a considerable space. In the posterior limb the femur resembles that of *Ichthyo-*

saurus. The tibia and fibula are longer than in that genus and are separated by a wide cleft. The anterior arch is ichthyosaurian excepting the scapula which is very broad. The posterior arch is very different from that of *Ichthyosaurus.* The skull is not well known. The dentition resembles that of *Mixosaurus.* The forms of this genus represent a distinct group of the Ichthyosauria. In some respects they are generalized and resemble *Mixosaurus,* in the other characters they show specializations which separate them from the other members of the family.

Ore Deposits of Shasta County: F. M. Anderson, Berkeley, Cal.

The copper belt of Shasta County, California, embraces, geologically, a series of old sedimentary rocks, Devonian, Carboniferous and Triassic, which extend in somewhat parallel bands northeasterly and southeasterly across the course of its longer axis. These strata have been penetrated and disturbed by intrusions of acid granolite, generally of the character of granite porphyry, though variable, which have been accompanied by flows of rhyolite and lavas resembling trachyte. In the vicinity of these intrusions and generally enclosed in the metamorphosed sedimentary rocks occur the deposits of sulphide ore which forms the subject of this paper. There are three or more types of ore represented among these deposits. The first class includes deposits found to the south of Pitt river near the mouth of the McCloud. They consist essentially of lenticular bodies of pyrrhotite carrying pyrite and chalcopyrite, but on the whole a low percentage of copper. These pyrrhotite bodies sometimes reach a thickness of 8 or 10 feet and a length of 50 or 60 feet, and are apparently connected with intrusions of dioritic rock. The second class of deposits is represented in all of the large ore bodies west of the Sacramento river, including the properties of the Shasta King, Balaklala, Iron Mountain and Mammoth mines. They are immense bodies of sulphide ore, consisting almost entirely of pyrite and chalcopyrite, with comparatively little zinc blende, but carrying both silver and gold. They appear to be replacement deposits, and have preserved in a measure the banded or stratified form of the original rocks. The largest of these deposits approximates 2,000,000 tons in extent. The grade of the ore varies from 1 to 20 per cent. in copper, averaging generally between 3 and 7 per cent., and carrying silver and gold to the value of $2.50 per ton. The ores of the Pittsburg and Afterthought districts, which constitute the third class, are similar to each other in character and probably in the mode of their occurrence. They are comparatively poor in iron and contain a larger percentage of zinc blende than any of the others. The ore includes little pyrite, consisting largely of chalcocite, bornite, chalcopyrite and other rich sulphides, with a gangue of silica and barite. The average grade of the ore at Bully Hill is nearly 10 per cent. copper with a relatively high value in silver and gold. The surface alteration in these deposits has resulted in the removal of the copper contents from the upper levels in which there is considerable concentration of gold and silver. In many cases the copper has found secondary lodgment in lower portions of the deposit, forming what is sometimes designated the 'copper level.' This secondary enrichment of the ore bodies is the rule throughout the whole extent of the copper belt. The grade and magnitude of these sulphide deposits entitle them to rank among the most important in the United States.

Lake Chelan, Washington: H. W. Fairbanks, Berkeley, Cal.

Lake Chelan is one of the most remarkable and interesting bodies of fresh water in the west. It is situated in an ancient valley upon the eastern slope of the Cascade range in northern Washington. The lake has a length of about 60 miles and a width of one to two miles. It has an elevation of 950 feet above the sea level and a depth of about 1,400 feet. The country surrounding the lower end of the lake is quite open and contains numerous settlers, but through the greater portion of its length it is inclosed by mountains which rise quite precipitously 3,000 to 5,000 feet. The valley in which the lake lies has had an interesting history. It was occupied in quite recent times by one of the largest glaciers upon the eastern slope of the Cascade range. Previous to that there was another lake here, but at a somewhat lower level. The earlier lake was probably raised but slightly above the level of the Columbia river, into which it must have emptied. In the opinion of the author the great depth of the lake is due not to the erosion of the glacier, but to the fact that it was the bed of a stream, and was cut out chiefly by stream erosion. The glacier undoubtedly enlarged the valley somewhat and may have deepened it a little. If this view is the correct one the valley in which the lake lies must have been eroded at a time when the level of the land with respect to the ocean stood many hundreds of feet higher. The Columbia lava plateau would interfere with the drainage of such a valley, so that it must have been excavated prior to the formation of the plateau. The lake is held at its present level of 325 feet above the Columbia river, from which it is distant only three miles, by a morainal dam. The lower end of the lake is shallow, but as far as known to the author there is no reason to suspect that bedrock would be encountered at about the level of the Columbia river, which would be the case if the bed of the lake had been dug out by the glacier.

Lake Quiberis, an Ancient Pliocene Lake in Arizona: Wm. P. Blake, Tucson, Arizona.

The San Pedro river of Arizona drains a considerable area, and is bordered throughout its course by mountain ranges forming a valley from ten to twenty miles in width and nearly one hundred and fifty miles in length. The valley is in general parallel with that of the Santa Cruz, the next great valley to the westward. A lake-like sheet of water of which we have good evidence filled the greater portion of this valley in late Tertiary or Quaternary time. This evidence is chiefly the presence on both sides of the valley of unconsolidated red clays and sediments in horizontal beds of great thickness, often terraced by the river erosion, and extending high up on the sides of the bordering mountains. One of the best cross-sections is found on the line of the Southern Pacific railway which crosses the valley nearly at right angles to its course at Benson. Benson, in the bottom of the valley, has an altitude of 3,576 feet above the sea. The river is about fifty feet lower. The lacustrine clays rise from this point on each side to the height of about 3,800 feet. The exact limit of clay deposition is not easily determined. It appears most probable that the height of the water was about 4,000 feet above tide. The sediments are similar to those around Benson, bordering the valley northwards, towards the Gila Valley. We there find also, in addition, the thick beds of diatomite mingled with fine volcanic ash. These diatoms are mostly marine species, according to Dr. D. B. Ward, of Poughkeepsie. But some fresh water forms are present. The Quiberis Valley thus appears to have been occupied by sea-water. It was open on the north to the great open valley of the Gila and Salt rivers and would appear to have existed as a partly landlocked estuary, at least in the upper portion between the

Dragoon Mountains and the Whetstones and Huachucas. The phenomena bear testimony also to the great epeirogenic uplift since the Miocene. A depression of four thousand feet would submerge the greater part of southern and southeastern Arizona, including the great valleys of the Gila river, Salt river and of the Santa Cruz, leaving only a few widely separated islands above the Pliocene Sea.

The Debris Fans of the Arid Region in their Relation to the Water Supply: E. W. Hilgard, Berkeley, Cal.

The debris fans or cones of the torrential periodic streams that enter the broad and deep valleys of the Cordilleran region are wholly different in their genesis and structure from the alluvial fans of the streams that enter lakes, as described by Gilbert (Monograph No. 1, U. S. Geol. Survey). Immediately in front of the cañon mouth we always find an accumulation of cobbles and boulders, the latter sometimes of enormous size; these grade off into smaller cobbles and gravel as the distance increases, but there is always an irregularly semi-elliptical area, of an extent proportioned to the size of the stream, on which the water is partly or wholly absorbed unless the discharge exceeds a certain amount, when a portion of it passes over the gravel area, carrying with it the finer materials, which are deposited beyond. As the valley is filled up and the slope decreases, it takes exceptional floods to carry the coarse materials to any great distance from the cañon mouth. Yet while the slope was steep and the valley channel relatively narrow, the cobbles were often carried to considerable distances. The water so absorbed in the coarse materials forms a pressure column behind the main body of the fan, which when large becomes a prolific source of artesian water, as is prominently exemplified in the upper San Bernardino valley and elsewhere in California. The extreme irregularity of structure within the fan, and the variations in the quantity and course of the main discharge of the stream, cause corresponding irregularity in the flows and static pressures of wells; high pressure being frequently coincident with small flows, and vice versa. Spontaneous outflows also frequently occur in times of high floods, or as the result of erosion on the fan slope. 'Artesian' springs and streams thus formed are important sources of irrigation water in southern California; they respond to the variations of the seasonal rainfall in from three to six months. Hence these debris fans form natural storage and regulating reservoirs of great importance. A striking example of the effect of these conditions upon the topography and hydrography of the valleys is afforded by the debris fan of San Antonio creek, a snow-fed torrent descending from the Sierra Madre northward of Pomona, Los Angeles County. Its typically regular fan has extended clear across the valley (nine miles) to the foot of the hills opposite, thus forming a water-divide between the Santa Ana and San Gabriel rivers. The creek itself has in the past evidently discharged alternately into the two drainage basins, which originally were probably a single one draining through the Los Angeles plain into the sea. This is an easily verifiable illustration of the manner in which the broad Cordilleran valleys have been filled in, as lately discussed by Shaler. Similar though less obvious examples exist in the Great Valley of California, as well as in the Santa Clara valley on San Francisco Bay.

A Post-Tertiary Elevation of the Sierra Nevada shown by a Comparison of the Grades of the Neocene and Present Tuolumne Rivers: H. W. Turner, San Francisco.

The Neocene Tuolumne occupied the

same drainage basin and followed approximately the same course as the modern stream. The most western point where the gravels of the Neocene Tuolumne have been preserved is east of the head of Big Humbug Creek in the Sonora quadrangle, and the most eastern Piute Canyon in the Yosemite quadrangle. If we now calculate the average grade of the Tertiary stream between these two points, and the average grade of the present river between the same points, we can compare the grades of the two streams. The altitude of the Neocene Tuolumne gravels at Big Humbug Creek is about 2,800 feet, and at Piute Canyon 7,500 feet, giving a difference of 4,700 feet. The altitude of the present Tuolumne north of Big Humbug Creek is 1,500 feet, and at Pate Valley, at the mouth of Piute Creek, 4,550 feet, giving a difference of 3,050 feet. The horizontal distance between the two points is about 33 miles. Assuming that both the Neocene and the present streams took a direct course, we have a grade of 142 feet to the mile for the Neocene channel, and a grade of 92 feet to the mile for the present channel. While the Neocene river occupied a rugged canyon, nevertheless this canyon was much less deep and rugged than that of the present Tuolumne, which implies, other things being equal, a higher grade for the present than for the Neocene channel, while, as we have seen, the reverse is the case. The broad channels and large sand and gravel deposits of the Neocene streams of the Sierra further north can scarcely be explained on any other hypothesis than of comparatively gentle grades, indicating an old age for the streams, and this must have been likewise true of the Neocene Tuolumne, although in less degree. Assuming that the Neocene Tuolumne had originally a grade at least as low as that of the modern stream, which is evidently yet a young stream, it is clear that the present grade of the Neocene channel must have been brought about by a differential uplift on the east, resulting in a tilting of the range westward.

On an Orbicular Gabbro from San Diego County, California: ANDREW C. LAWSON, Berkeley, Cal.

The rock described in this paper is a very basic gabbro in the form of an aggregation of spheroids having both radial and concentric structure. The spheroids have an average diameter of about 6 centimeters, but are mostly somewhat deformed in shape. The core of these spheroids is a granular gabbro and the space between the spheroids is of a similar character. An analysis of the rock is given.

A Geological Section of the Middle Coast Ranges of California: ANDREW C. LAWSON.

The paper is an attempt to summarize recently acquired information as to the sequence of formations and their respective volumes of sediments in the Middle Coast Ranges of California. The results given for the thickness are approximations sufficiently close to afford a general idea of the section. Other features of the paper are the subdivision of the Franciscan into seven stratigraphic subdivisions by the recognition of a persistent horizon of foraminiferal limestone and two important horizons of radiolarian chert; a similar subdivision of the Monterey into seven stages and a summary announcement of the character and history of the post-Monterey Tertiary. The essential features of the paper are given in the following tabulation.

The Pleistocene Ecology of Southern California: RALPH ARNOLD, Stanford University, California.

A summary statement of the marine Pleistocene of San Pedro and other localities of southern California with a subdivision of the Pleistocene formations partly on the basis of structural unconformities

GEOLOGICAL SECTION OF THE COAST RANGES OF CALIFORNIA IN THE VICINITY OF THE BAY OF SAN FRANCISCO.

			Thickness. Feet.
Merced		Upper marine sandstones, sandy shales and clay shales; Lower marine clays, sandy shales, sandstones, fine pebbly conglomerates	5,830
Unconformity.			
Campan		Volcanics, andesites, basalts, rhyolite agglomerates	
		Fresh water, conglomerates, sandstones, clays, limestones	500
Unconformity.			
U. Berkeleyan		Volcanics, basalts and tuffs	
		Siestan, fresh water, clays, limestones, sandstones, shales, lignite, tuffs, conglomerates,	200
		Volcanics, andesites, basalts, rhyolite tuffs	
Unconformity.			
L. Berkeleyan		Volcanics, andesites, basalts, rhyolite tuffs	
		Trampan, marine shales, sandstones, pebbly conglomerates	2,000
		Orindan, fresh water conglomerates, sandstones, clays, limestones, tuffs	2,400
Pinole—Tuffs (pumiceous) fossiliferous			1,000
San Pablo—Blue tuffaceous sandstone, marine			1,500
Unconformity.			
Monterey	Upper	Stage 7—Sandstone	1,800
	Middle	Stage 6—Bituminous shale	670
		Stage 5—Sandstone	1,200
		Stage 4—Bituminous shale	460
		Stage 3—Sandstone	600
		Stage 2—Bituminous shale and chert	250
	Lower	Stage 1—Sandstone	400
Unconformity.			
Karquinez		Tejon—Massive sandstones	2,100
		Martinez—Massive sandstones	2,200
		Rhyolite flows. (Age not certainly determined).	
Unconformity.			
Shasta-Chico		Chico—Sandstones and shales	3,000+
		Oakland—Conglomerate	500
		Peridotite irruptions.	
		Knoxville—Shales with subordinate limestone and conglomerate	1,000
Unconformity. Volcanics.			
Franciscan		Bonita sandstone	1,400
		San Miguel cherts, radiolarian	530
		Marin sandstone	1,000
		Sausalito cherts, radiolarian	900
		Bolinas sandstone (volcanics)	2,000
		Volcanics.	
		Calera limestone, foraminiferal	60
		Volcanics.	
		Pilarcitos sandstone	790
			34,290
Unconformity.			
Montara granite (correlated tentatively with late Jurassic granite of Sierra Nevada).			

and partly on the basis of their fossil fauna.

A Contribution to the Petrography of the John Day Basin: F. C. Calkins, Berkeley, Cal.

The paper is based on a study of specimens gathered during the last three summers, by the University paleontological expeditions conducted by Dr. J. C. Merriam. It may be considered as a supplement to Dr. Merriam's 'Contribution to the

Geology of the John Day Basin.' The igneous rocks of pre-Eocene age comprise quartz-mica diorite, serpentines and pyroxenite. The Tertiary series, including the fossil-beds, is almost entirely composed of volcanic materials. The Clarno Eocene began with the eruption of andesitic lavas and tuffs, followed by quartz-basalt and rhyolite. The John Day Miocene beds are mainly tuffs of trachytic and andesitic character. Upon them lie the great basalt series, which is in turn overlain by the Mascall beds, similar in general composition to the John Day. The Pliocene Rattlesnake formation comprises rhyolitic lava and tuffs. The most recent evidence of volcanic activity consists in ash-beds interstratified with the terrace gravels.

Colemanite: ARTHUR S. EAKLE, Berkeley, Cal.

The paper contains the results of a crystallographic study of a large number of colemanite crystals from the Calico district, San Bernardino, Cal. The crystals are exceptionally rich in forms and in the number of well-developed faces. Although only showing terminations on one end of the vertical axis owing to their attachment to the matrix, seldom less than twenty faces are present, and some of the combinations if completed would show upwards of one hundred faces. About fifty forms occur, of which one third are new. Four quite distinct habits are noticeable, governed by the absence or predominance of certain of the terminal forms. The measurements were made with the two-circle goniometer designed by Goldschmidt, and since this important method is comparatively new to the mineralogists of this country, a detailed description of the work is given, in order to make clear the method of calculating and projecting the forms. The figures accompanying the paper are a gnomonic projection of the forms, an orthographic projection on the base and several clinographic projections illustrating the varied habits and combinations observed.

Eocene and Earlier Beds of the Huerfano Basin, Colorado, and their Relation to the Cretaceous: R. C. HILLS, Denver, Colo.

The paper discusses the stratigraphical and structural features of the Huerfano Eocene, and associated Upper Cretaceous beds, for the purpose of correcting certain errors that appeared in earlier papers on the subject. The uppermost beds previously assigned to the Eocene have been shown to contain a Wind River and Bridger fauna, but there is a much greater thickness of conformable beds of similar character, the age of which has not been definitely established, which it is thought should be provisionally correlated with the Lower Eocene of the Uinta and San Juan basins. The Lower or Poison Canyon formation is found to be unconformable with the true Eocene and with the underlying Cretaceous, and to present a strong contrast with the latter lithologically. It is suggested that the Poison Canyon beds are nearly related to, if not identical with, the post-Laramie formation of the Denver Basin.

ANDREW C. LAWSON,
Secretary.

A NEW BAROMETRY FOR THE UNITED STATES, CANADA AND THE WEST INDIES.

A NEW system of reducing the barometric observations of pressure at the stations of the Government Services of the United States and Canada was put in operation on January 1, 1902. The Weather Bureau has received all the data necessary for carrying on the Canadian computations simultaneously with its own, through the courteous cooperation of Professor R. F. Stupart, Director of the Canadian Meteorological Office. The reduction of pressures observed on the Rocky Mountain plateau to sea level is a problem of great scientific difficulty for two reasons: (1) Because it is not evident what the exact effect of the plateau is as modifying the ordinary Laplacean free air reduction, even when the mean temperature of the air column θ is assumed; and (2) because the vertical temperature gradient between the observed surface temperature t and the sea-level temperature t_0 is difficult to determine, or in other words because the connection between $\frac{1}{2}(t+t_0)$ and the true θ is hard to find. The solution of this problem has been forced upon the Washington Office ever since the opening of the service in 1870, inasmuch as the results of such reductions are used to form the daily weather maps, and the errors of reduction result in inaccurate systems of isobars, and consequently incorrect deductions regarding the existing weather conditions, especially west of the Mississippi Valley. The perplexity of the problem may be inferred from the fact that the present system constitutes the sixth effort to solve it. The indications are that the new isobars conform very closely to the true weather, and that the practical working of the system will prove to be satisfactory to the Bureau.

A brief summary of the earlier methods of reduction is as follows:

1. For the years 1870–81 all the low stations were reduced by an elementary application of tables given in Loomis' 'Meteorology' (the same as Guyot's table D, XVI., edition of 1859), using the temperatures observed at the moment of observation. 1872–1880. The higher stations were not reduced except by the application of a constant appropriate to the mean annual temperature and pressure; the lower stations continued with the elementary method, but this included an erroneous use of the observed pressure.

2. 1881–85. The Abbe-Upton system of monthly constants for each station, based on the mean monthly temperatures and pressures.

3. 1886–1887. Ferrel's system was in operation but found to be in a form which was too complicated for practical station work. However, some correct principles were introduced by him, namely, the mean temperature of twenty-four hours as the argument instead of the temperature at the time of observation; a separate correction for the plateau effect; the variation of the reduction with the local pressure; and a correction of the surface temperature t to the mean θ by an approximate vertical gradient.

4. 1888–1890. A mixed system, partly Ferrel's and partly Hazen's. 1891–1901. Hazen's empirical system alone, in which numerous changes were made in the wrong direction. The plateau correction was omitted, the pressure argument was abandoned, and the surface temperature not corrected to θ became the only argument. In constructing the empirical tables it was assumed that Mt. Washington is a correct type for the plateau effect, which is not true; the pressure on the sea level was taken as exactly 30.00 inches in working out the reductions, which does not conform to the facts; the check upon the reduction was limited to the criterion that the isobars could be smoothly drawn, and reductions for many stations received arbitrary modifications for that purpose. The result of this system was to give too high sea-level pressures at low temperatures, especially in cold waves, and too low pressures in warm weather.

5. In 1896 Professor Morrill computed tables which have been used somewhat in the office, but never published, in which the mean temperature θ and the pressure arguments were restored, and the treatment of the humidity put on an improved

basis, though the plateau effect was omitted and the correction between t and θ only roughly determined.

The following statement will indicate the most important changes which have been recently adopted. The principles introduced by Ferrel have been more closely followed than any of the others, but decided improvements have become possible by reason of the gradual accumulation of accurate observations on the plateau. It was first necessary to construct exact normals of station pressure. There have been numerous changes in the location of the offices during the past thirty years, involving variations in the elevation; there has been a gradual improvement in the general national surveys for elevation by which the local bases can be referred to the sea level; the instrumental errors were neglected during certain years when less than $\pm$ 0.007 inch; the observations have been made at different sets of selected hours; and the gravitation correction was not regularly applied. To reduce the entire set of observations from 1873 to 1900, inclusive, to a homogeneous system, they have been corrected to the elevation adopted for January 1, 1900, or the one occupied nearest that date, also to the mean of twenty-four hourly observations, and the corrections for instrumental errors and gravity have been added systematically. The monthly and annual means give the normals, and from these the variations in the year and from year to year are computed, the latter becoming the basis for the further discussion of climatic and seasonal problems.

The process of determining the sea-level temperature beneath the plateau was conducted as follows: The normal mean monthly temperatures of all stations between the Pacific coast and the Mississippi river were collected by groups according to their elevations, and reduced to selected planes through short distances. Thus all temperatures observed between 0 and 1,000 feet were corrected to the 500-foot plane, between 1,000 and 2,000 to the 1,500-foot plane and so on up to 7,000 feet. Temperature gradients in latitude and longitude were worked out by discussing these data, and then all the data on the selected planes were further corrected to values on the centers of reduction, that is the points where the five-degree meridians and the five-degree parallels intersect. The several stations were carried in various directions to different centers, so that purely local conditions might neutralize themselves. Over these centers we have thus formed from the observations different temperatures in a vertical direction, and they were then plotted as points on diagrams through the average of which vertical temperature curves were drawn, and prolonged to sea level without much error. These sea-level temperatures were now transferred to charts of the United States and Canada, and in connection with all the stations available from the Atlantic to the Pacific coasts, sea-level isotherms were readily drawn, by which all the minor discrepancies occurring in the plateau district were removed. By interpolation we then found the true terminals of the vertical temperatures at sea level on the centers of reduction. This entire work was performed two or three times in succession by a series of approximations, and the interlocking of the vertical and horizontal lines on the sea-level plane were made to conform to the observed conditions. Thence the sea-level temperatures for the respective stations were found by interpolation from the isotherms to tenths of a degree, so that we have thus accurately obtained t_0 as well as t.

The plateau effect was determined on the theory that the wide swing of the temperatures in the annual period, amounting to 0.400 inch, should be reduced to that which is observed at the low-level stations, about 0.150, by a correction of the form $C. \Delta\theta .H.$, where C=0.00100, $\Delta\theta$ is the departure of the temperature from the annual mean, and H is the elevation in units of a thousand feet. This is readily computed for each station, and it is to be added to the free air correction computed by the Laplacean formula with modern constants.

The monthly station pressures B were now reduced to sea level, giving B_0, and isobars were drawn as well as possible through the resulting values. Many of the old stations had their elevations determined only by barometers and were quite erroneous; in many cases the temperature argument used $\frac{1}{2}\ (t+t_0)$ was not exact enough to give very accurate results; not a few stations had only a short series of years to use in constructing their normals; from these causes considerable irregularities were found on the first system of sea-level maps. The pressures for each station were now interpolated from the map, B_m, and the differences, B_0–B_m, computed. For certain stations these differences were about constant, indicating an error in the adopted elevation, or in the mean temperature from which the plateau effect was reckoned; in other cases the differences had a variation in an annual period, showing that the true value of θ differs from $\frac{1}{2}\ (t+t_0)$. By readjusting our data to allow for all these considerations, the sea-level pressures were computed a second time. The differences, B_0–B_m, were now quite small for stations of long record, usually less than 0.010 inch. Assuming that the normal values of the short record stations should be reduced to the long record series, that is, 20 to 27 years, these last residuals were added to the original station pressures B to give the station homogeneous normals B_n. There still remain a few stations, some of them at low level, so that any adopted method of reduction cannot be a possible source of error, wherein a nearly constant residual reduction is yet required to reduce them to the homogeneous system, marked ΔA. This is probably due to some local peculiarity of the wind circulation, or the exposure of the barometer, and it may properly be considered as a topic for further investigation.

We next proceeded to make reductions for all the stations now in operation to the 3,500-foot plane and the 10,000-foot plane, both of which are useful in the studies of cyclones and anticyclones, but instead of directly from B to B_1 and B_2, by a roundabout circuit. The sea-level values $B_m .\ t_0 .\ e_0 .$ pressure, temperature, vapor tension, were interpolated on the centers of reduction from the sea-level charts. The temperatures $t_1 . t_2$ and the vapor tensions $e_1 . e_2$, on the two upper planes, respectively, were computed by gradients derived from the cloud computations of 1896–97, and balloon and kite ascensions. With this data charts of $t_1 . t_2 . e_1 . e_2 .$ were formed, the pressures $B_1 . B_2 .$ on these planes were computed by means of our new logarithmic general tables, and the corresponding pressure charts drawn. Thence the station data $B_1 . t_1 . e_1 .$ for the 3,500-foot plane and $B_2 . t_2 . e_2 .$ for the 10,000-foot plane were interpolated for each month and for the annual mean. As a check, station data $B_n\ . t . e.$ were reduced so as to give corresponding to B_n the values of B_1 and B_2. We have thus derived $B_1 . B_2 .$ by two separate methods, and they generally agree to about 0.01 inch on the average. This check includes the construction of the general tables and the special station tables, also the drawing of the different sets of charts. We have therefore obtained the same results by means of two paths of reduction, the first to sea level from the station, and thence through the centers of reduction to the two higher planes, and thence by interpolation to points over the station; the second, from the station pressure to the pressures on the two other planes directly. This agreement, therefore, unites the entire data in a homogeneous system, and it becomes the basis for future substantial scientific discussions in many meteorological problems. We can now deal quite confidently with hundredths of an inch of pressure.

A full report on this subject will appear in the Annual Report, Chief of Weather Bureau, Vol. II., 1900–1901, and will contain the following sets of charts for each month and for the year, $B_m \cdot t_0 \cdot e_0$. and the relative humidity on the sea level plane, $B_1 . t_1 . e_1$ on the 3,500-foot plane, $B_2 . t_2 . e_2$ on the 10,000-foot plane, 130 in all; also charts of gradients in latitude, in longitude and in altitude, as well as charts for reducing selected hours of observation to the mean of twenty-four hourly observations. With these data a newly opened station can by a little computation be put on a better basis regarding its normals than would be given by at least ten years of regular observations. A summary table contains the above list of normals for 265 stations besides the original data for the station $B_n . t . e.$, and will be a valuable source of reference for numerous questions in meteorology.

The reduction tables for pressure consist of three different sets: (1) The general logarithmic tables computed for every 100 feet up to 10,000 and for every 10 degrees from $-40°$ to $+100°$; (2) the station tables for publication, containing the following corrections for each of our three planes of reference, sea-level, 3,500-foot and 10,000-foot, namely, the Laplacean free dry air correction, the humidity correction, the correction for the plateau effect and the occasional residual correction, also the two arguments t surface temperature and θ the mean column temperature. Diagrams have been constructed to show the relations between t and θ, and they form a most instructive analysis of the plateau temperature problem, showing that each district has local characteristics of its own; (3) the station tables are compiled from the forms (2), and they are expanded for the arguments surface t and surface B, so that there shall be no interpolation along the temperature argument in order to obtain the nearest hundredth of an inch, 0.010. The body of the table gives the reduced pressure on its plane, and not the correction to the actual pressure, which must be added to it to produce the reduced pressure, as is customary in such tables. There remains only a very simple interpolation for the intervals of a tenth of an inch of pressure to the required hundredth of an inch. It is thus an easy matter to enter the three tables in succession with the same arguments, surface $(B . t)$, and find $B_0 . B_1 . B_2$. These data will enable us to construct three sets of isobars at each hour of observation, showing three plane sections through the atmosphere, and these will probably prove to be of value in the forecasts of the weather conditions. The sea-level reductions went into operation on January 1, 1902, as stated, but some more work is required to furnish the stations the necessary tables of group (3), the two preceding groups being completed.

FRANK H. BIGELOW.
WEATHER BUREAU.

SCIENTIFIC BOOKS.

Memorial Lectures delivered before the Chemical Society of London, 1893–1900. London, Gurney and Jackson, Paternoster Row. 1901. 8vo.

This volume contains the lectures commemorating deceased honorary and foreign members of the Chemical Society of London, delivered during the eight years designated in the title, and if we take into consideration the historic eminence of the subjects of the lectures, as well as the fitness of the lecturers for their biographical tasks and their success in preparing them, it is safe to say that no more important or fascinating contribution to the history of chemistry has been issued within the decade. In each case care was taken to select as the lecturer one who had been personally intimate with the deceased chemist, or who was especially well qualified to write of his researches with the sympathy born of studies analogous to his; the result forms an illustration of the international character of science, for the native of Belgium is portrayed as to his life and labors by an American, the native of Switzerland by a Swede, the Germans by Englishmen, a Frenchman by another American, and only one lecture, on a Swede, is by a compatriot.

The methods followed by the lecturers in dealing with the individuals assigned them vary considerably, but the majority depict the personality of the chemist, his domestic life, his official duties, his positions of honor, and after these his labors and discoveries in the field of chemistry; in several instances the biographer introduces valuable disquisitions bearing on the theories which the person portrayed founded or helped to establish. Professor J. W. Mallet, of the University of Virginia, writing of Jean Servais Stas, precedes his account of the life-work of the Belgian in the determination of atomic weights, with a careful summary of the fundamental ideas that gradually led up to the question, 'What is the mass (or weight) of an atom of a particular element?'; and he presents a clear statement of investigations as to the atomic weight of the elements from the time of Berzelius to that of Stas. At the beginning of his painstaking researches Stas had an almost absolute confidence in the accuracy of Prout's hypothesis, but at their conclusion he said, 'The theory of Prout must be considered as a pure illusion.' Mallet himself, however, seems inclined to believe that there may be still something in it.

In passing, let me say that the biographer of Stas falls into the error of assigning to Wenzel a share in the discovery of the law of neutrality, an error originating with Berzelius, and often repeated, but corrected by J. S. C. Schweigger, Angus Smith, Ladenburg and by others.

In his lecture on Marignac, the Upsala professor, Cleve, introduces a skilful survey of the complicated history of the rare earths, including a table giving the characters of the elements of the yttrium-cerium groups that was highly esteemed at the date of its publication (1895).

Dr. W. H. Perkin, in his sketch of the labors of Hofmann, introduces an authoritative account of the origin of the coal-tar color industry, and both Drs. Japp and Thorpe in their lectures on Kekulé and on Victor Meyer, respectively, insert most praiseworthy contributions to the history of those branches of organic chemistry in which each was laboring so successfully.

These disquisitions do not partake of padding, but are among the most valuable features of this very valuable volume.

One of the most difficult men to treat, on account of his gigantic intellectual position, Helmholtz, is presented in a masterful way, notable for its vigor and brevity, by Dr. Geo. F. Fitzgerald.

Dr. Percy Frankland's biography of Pasteur is very readable and appreciative; he points out that the French chemist long ago 'completely foreshadowed and grasped that important branch of our science which we now call stereo-chemistry' as shown by the philosophical reflections made by Pasteur after his discoveries in connection with racemic acid. Some bold experiments conducted by Pasteur were designed to accomplish 'the task of turning the Creator's world upside down'; one of these was carried on at Lille in 1854. He had a clock arranged with heliostat and reflector, to reverse the natural movement of the solar rays striking a plant from its origin to its death, so as to ascertain whether in such an artificial world, in which the sun rose in the west and set in the east, the optically active bodies could be obtained in enantiomorphic forms. Dr. Frankland reviews Pasteur's studies on fermentation, his researches on spontaneous generation, on the vinegar process, on the diseases of wine, of silkworms, and the beneficent results of his success in combating disease in man himself. Of the 20,000 persons who have taken antirabic treatment, the mortality has been less than five per thousand.

The four lectures on August Wilhelm von Hofmann occupy the most space given to any individual in the volume; Lord Playfair writes of his personal reminiscences of Hofmann and of the conditions which led to the establishment of the Royal College of Chemistry; Sir F. A. Abel narrates the history of the same College and of Hofmann's professional work therein; Dr. W. H. Perkin chronicles the contributions of Hofmann and his distinguished pupils to coal-tar color manufactures; and Professor Henry E. Armstrong contributes a very full and careful analysis of the scientific work of this great master in research.

Professor O. Petterson, of Stockholm, writes of Nilson; Sir Henry E. Roscoe in a delightful sketch of Bunsen, his intimate friend and teacher, mentions many amusing episodes of the absent-minded, genial, big-framed man who has been loved by all who came into contact with him; Dr. P. P. Bedson portrays Lothar Meyer; Professor J. M. Crafts, of Boston, writes of his warm friend, Friedel; and Dr. Thorpe, of London, writes of the brilliant Victor Meyer as well as of Hermann Kopp. With each of the twelve lectures there is an excellent portrait of the person sketched, and most of the lectures contain valuable bibliographies. A copy of this memorable volume (of which the edition is limited to 500) should be found in every good library.

HENRY CARRINGTON BOLTON.

Allgemeine Physiologie. Ein Grundriss der Lehre vom Leben. By MAX VERWORN. Third edition, revised. Jena, G. Fischer. 1900. Pp. 631; illustrations 295.

The facts that Professor Verworn's book has reached its third German edition, and that it has been translated into English, French, Russian and Italian, are evidence of its worth. That it has exerted an influence on the development of physiology during the six years of its existence is indicated by the frequency of references to it in physiological literature. The book improves with each successive edition. In its present revision it is unchanged in its fundamentals, but from the first to the last page it gives evidence of having been thoughtfully worked over. Apart from the alterations obligated by the newer researches, portions of the previous editions have been omitted, portions have been rewritten, and the language has constantly been made more precise. The quantitative result is an addition of twenty-five pages and ten figures, while qualitatively there is a betterment throughout. A few of the special features of the new edition may be here mentioned.

The use of the word *Eiweisskörper* has largely given place to that of *Eiweissverbindungen,* and stress is laid on the fact that the life process consists in the metabolism of the compounds of proteids rather than of proteids alone. The section on ferments is largely rewritten. As Emil Fischer has shown, it is now recognized that each ferment acts on one specific chemical body only, and not even on the isomers of that body. In many cases of ferment action by organisms, but not necessarily in all, the efficient substance is not the organism itself, but something secreted by the organism. Buchner proved this for alcoholic fermentation by the yeast-cell, and gave the name *zymase* to the enzyme. Another fact of interest is that no synthetic ferments have yet been discovered. Attention is called to the well-known results of Loeb and others in artificial parthenogenesis. Peter's observations that in ciliated cells the basal bodies are the place of origin of the impulse to movement are quoted. Peter's idea is supported by the work of Gurwitsch on the development of cilia.

The paragraphs on the origin of the current in a voltaic cell are rewritten and Sohncke's theory is replaced by that of Nernst. According to Nernst, metals have a great tendency to give off their molecules as cations in solutions of certain salts, the amount of loss depending on the relation of the osmotic pressure of the solution to the solution pressure of the metal; the less the former and the greater the latter, the more cations are given off, and *vice versa.* The result of the loss is a charging of the metal with negative and of the solution with positive electricity. A second metal introduced into the solution, with a different relation of osmotic pressure and solution pressure, becomes charged positively, and the result is a difference of potential between the two metals.

In discussing the action of the galvanic current on protoplasm, the question is raised as to how the well-known effects are brought about. A possible factor is the electrolysis of the medium surrounding the living substance, in which case galvanic stimuli should be regarded as chemical stimuli. Verworn regards this possibility as doubtful, and if it occurs at all, it must be altogether subordinate. Much more important, doubtless, is the direct electrolysis of the living substance itself. A possible factor in the galvanic action is the movement of the liquids in the porous cell substance. This is suggested by the work of Carlgren, who, by the action of strong galvanic currents on dead cells, was able to obtain phenomena closely analogous to those occurring in living substance. The relative shares taken by these various factors in galvanic action must be decided by future investigation.

Molisch's work on the death of plants by freezing is noted, the general conclusion being that in such cases death is due to the abstraction of water from the protoplasm and the resulting profound alteration in the chemical structure of the compounds of the protoplasm. Regarding the action of chemical stimuli, the author takes the conservative position that in many cases, but not in all, osmotic action is associated with purely chemical action. The two factors have been only rarely distinguished sufficiently, and in most cases it remains to be decided to what extent the stimulating power of the chemical substance is due to its chemical, and to what extent to its osmotic properties.

The observations of Weil and Frank, which tend to disprove the hypothesis of the contractility of the dendrites of nerve cells, are quoted approvingly. So also is the work of Myer and of Overton, who found that the solubility of narcotics in fats and oils is a great factor in their narcotizing power. Narcosis is accomplished through the agency of the undivided molecule of the narcotic, not through its decomposition products. Narcosis appears to be a contact effect.

The author devotes a page to the discussion of the effect of the Roentgen rays on organisms, but the facts so far discovered are too few to allow conclusions of value to be drawn.

In discussing the origin of life the theory of F. J. Allen is added to those heretofore given. This author believes the beginnings of life to date, not as Pflüger assumes, from the time of the earth's incandescence, but from the period when water first appeared on the earth's surface. The powerful shocks of lightning which must have occurred continually in the damp, warm atmosphere then existing, led to the production of ammonia and the oxides of nitrogen, as happens to-day. These substances were carried down in solution by the rains, and on the surface of the earth met solutions of carbonic acid and the chlorides, sulphates and phosphates of the alkalies and metals. Thus the opportunity was given for the most varied nitrogenous combinations, and the first living substance then came into being.

The chapter on the mechanism of life is not greatly altered. The 'biogen hypothesis,' as the author now terms it, is considered somewhat more fully than before, in the light of the work of Detmer, Loew and F. J. Allen, but it is not essentially changed. Attention is called to Jennings's careful work on the mechanism of tactic movements, and to Rhumbler's interesting physical analyses of cell phenomena.

In the preface Professor Verworn speaks of the present great activity of investigators in all fields of general physiology, and laments the fact that within the narrow confines of one book so many of the important contributions must be mentioned without discussion or be omitted altogether. Notwithstanding this fact, his book still remains by far the best existing treatise on the varied subjects included under its comprehensive title.

FREDERIC S. LEE.

COLUMBIA UNIVERSITY.

SCIENTIFIC JOURNALS AND ARTICLES.

THE February number (Vol. VIII., No. 5) of the *Bulletin of the American Mathematical Society* contains a report of the eighth annual meeting of the Society, by the secretary; a report of the January meeting of the Chicago Section, by T. F. Holgate; a review of Wilson's Vector Analysis, by Alexander Ziwet; a review of books by M. Simon and J. M. Hill on Euclid, by J. S. Coolidge; 'Notes' and 'New Publications.' The March number of the *Bulletin* contains the following articles: 'The Application of the Fundamental Laws of Algebra to the Multiplication of Infinite Series,' by Florian Cajori; 'Concerning the Class of a Group of Order p^m that Contains an Operator of Order p^{m-2} or p^{m-3}, p being a Prime,' by W. B. Fite; 'Proof that the Group of an Irreducible Linear Differential Equation is Transitive,' by Saul Epsteen; 'Lines of Length Zero on Surfaces,' by L. P. Eisenhart; 'Some Properties of Potential Surfaces,' by Edward Kasner; a review of Gibson's Calculus, by W. F. Osgood; 'Shorter Notices' of Cohen's Theory of Numbers and Beman's translation of Dedekind's Essay on the Theory of Numbers, by L. E. Dickson, and of the Annuaire des Bureau des Longitudes, by E. W. Brown; 'Notes' and 'New Publications.'

The American Naturalist for February opens with an article by W. M. Wheeler on 'A New Agricultural Ant from Texas, with remarks on the known North American Species,' the new ant being *Pogonomyrmex imberbiculus*, while the notes include a key for the identification of the species. Under the caption '*Phyllospadix* as a Beach-builder,' R. E. Gibbs presents some new information regarding its life-history and shows how its spreading tufts hold the sand and produce sand-bars. G. H. Shull gives 'A Quantitative Study of Variation in the Bracts, Rays, and Disk Florets of *Aster Shorti* Hook., *A. Novæ-angliæ* L., *A. puniceus* L. and *A. prenanthoides* Muhl., from Yellow Springs, Ohio.' The number contains the 'Quarterly Record of Gifts, Appointments, Retirements and Deaths,' and it is noted that hereafter these will appear in the numbers for February, May, August and November. The gifts for the past year to schools, colleges, libraries and museums amounted to $43,233,635, and this does not include Mrs. Stanford's transfer of securities to Stanford University nor any appropriations made by national, state or local governments.

The Popular Science Monthly for March contains a long and well-illustrated article by J. C. Branner on 'The Palm Trees of Brazil,' describing the appearance and uses of many species. Alexander F. Chamberlain treats of 'Work and Rest: Genius and Stupidity,' drawing the inference that brief periods of intense work and long periods of rest produce better results than long periods of steady application. 'Science in 1901' is a résumé of progress along various lines from wireless telegraphy to the better understanding of yellow fever, reprinted from the London *Times*. Ellis P. Oberholtzer describes 'Franklin's Philosophical Society,' the oldest scientific society in the country, and W. H. Dall contributes an appreciative biographical sketch, with portrait, of the late Alpheus Hyatt. W. G. Sumner tells of the comparatively recent extraordinary outbreak of 'Suicidal Fanaticism in Russia,' and Lindley M. Keasbey discusses 'The Differentiation of the Human Species,' believing that mankind was homogeneous prior to the glacial period. E. B. Titchener, after considering the problem 'Were the Earliest Organic Movements Conscious or Unconscious,' decides in favor of the necessity of mind at the first appearance of life. Finally we have the full text of the 'Trust Deed by Andrew Carnegie creating a Trust for the benefit of the Carnegie Institution.'

SOCIETIES AND ACADEMIES.

AMERICAN PHYSICAL SOCIETY.

THE regular bimonthly meeting of the Physical Society was held at Columbia

University on Saturday, February 22. The severe storm in the region near New York at that time delayed the arrival of many of those present, and doubtless prevented others from coming. But the attendance was satisfactory in spite of the storm, and the meeting an enjoyable one.

A paper on the 'Velocity of Light,' by President Michelson, took the place of the president's annual address, which could not be delivered at the holiday meeting of the Society on account of Professor Michelson's unavoidable absence. The paper contained a brief discussion of the various determinations of the velocity of light, together with the determinations of the ratio of the electrostatic and electromagnetic units, and of the velocity of electric waves. The conclusion was reached that the great theoretical importance of demonstrating, or disproving, the absolute equality of these three quantities made a redetermination of the velocity of light desirable. Certain criticisms, from the theoretical standpoint, of the revolving mirror method, which up to the present time has given the most consistent results for V, were also mentioned. A method was proposed which combined the advantages of both the method of Cornu, in which a toothed wheel was used, and the method of the revolving mirror, as used by Michelson and by Newcomb. While free from the objections that have been suggested in connection with the latter method, the method proposed promises a higher accuracy than has ever heretofore been reached.

In a paper on 'Magneto-striction in Bismuth,' by A. P. Wills, experiments were described which were intended to detect any change in length in bismuth produced by longitudinal magnetization. Similar tests by Bidwell had shown an appreciable elongation for a magnetic field of less than 2,000 c. g. s. units. The experiments of Professor Wills were made with a stronger field and with an arrangement of levers of sufficient sensitiveness to show a much smaller elongation than that reported by Bidwell; but no effect could be observed.

In a paper entitled, 'The Transmission of Sound Through Solid Walls,' Mr. F. L. Tufts gave the results of determinations of the transmitting power for sound of various nonporous walls. The results were in many respects different from what would probably be anticipated from a hurried consideration of the case. For example, a wall of sheet lead, in spite of its great density and its lack of elasticity, was found to transmit much more sound than a glass wall of equal thickness. Two walls separated by an air space were no more effective in cutting off sound than the same two walls in contact. The results indicate that the sound is transmitted in such cases by the forced vibration of the wall as a whole, not by the elastic waves carried through the wall. Other things being equal, that medium which yields most to pressure steadily applied will transmit best.

Professor A. G. Webster, in a paper on the 'Spherical Pendulum,' showed some very pretty traces illustrating the vibrations of a pendulum whose motion is not restricted to one plane and whose amplitude is large. The traces were made by photographing the path of a small incandescent lamp attached to the pendulum bob. The theory of such a pendulum was briefly discussed, and it was shown that the traces actually observed were in close agreement with those predicted by theory.

Certain distorted coronas, produced by a medium containing drops of moisture of different sizes, were described by Carl Barus in a paper entitled 'The Flower-like Distortion of Coronas Due to Graded Cloudy Condensation.' The author developed the theory of such coronas and showed that it was in agreement with observation.

A second paper by Professor Barus dealt with 'Persistent Nuclei Produced by Shaking Solutions of Solids, Liquids or Gases.' The author stated that whereas the nuclei produced by pure water were very fleeting, nuclei produced by solutions persisted until removed by gravity. It follows that small droplets of solutions do not evaporate below a certain dimension, very large compared with molecular dimensions.

The results of measurements of the current between a cold metal and an incandescent carbon kathode were presented in a paper by

Ernest Merritt and O. M. Stewart. Curves were shown giving the observed relation between current and potential difference for different degrees of incandescence and for different air pressures. At low pressures (0.05 mm. or less) these curves were similar to the 'saturation' curves observed in the case of conduction due to Röntgen rays, etc. With increasing potential difference the current at first increased, reached a maximum at about six volts, and then remained practically unaltered for higher potentials, even up to 120 volts. At pressures in the neighborhood of one millimeter the curves were of the same character at low potentials; but instead of remaining constant throughout the whole range from six volts to 120 volts, the current remained unaltered until a potential difference of about thirty volts was reached, and then increased rapidly for higher voltages. The authors suggest that the result may be explained by the ionization of the residual gases by the negative ions from the incandescent carbon.

The Society voted to request the Council to arrange for a summer meeting of the Society in connection with Section B of the American Association for the Advancement of Science.

ERNEST MERRITT.

AMERICAN MATHEMATICAL SOCIETY.

A REGULAR meeting of the American Mathematical Society was held at Columbia University on Saturday, February 22. Vice-President Maxime Bôcher occupied the chair. Thirty members were in attendance at the two sessions. The Council announced the election of the following persons to membership in the Society: Professor Edward Brand, Howard College, Ala.; Mr. D. R. Curtiss, Harvard University; Miss Alice B. Gould, Boston, Mass.; Dr. Carl Gundersen, Columbia University; Mr. A. F. van der Heyden, Middlesbrough, Eng.; Rev. Jean de Seguier, S. J., Paris, France; Mr. J. W. Young, Cornell University. Fourteen applications for membership were received.

The term of Professor T. S. Fiske as member of the editorial board of the *Transactions* having expired, he was reelected for a term of three years. Dr. Edward Kasner was reelected assistant secretary. It was decided to hold the next summer meeting of the Society at Evanston, Ill., about the end of August.

The organization of a Pacific Section of the Society is now under consideration. The activity and number of members on the Pacific slope would appear to justify the Council in granting the desired authorization. The Chicago Section, founded in 1898, has proved a gratifying precedent.

The Annual Register of the Society has recently appeared, containing the list of officers and members, annual reports, constitution and by-laws, and a complete list of all periodicals now in the Society's library. The total membership of the Society is now 379, of whom 18 are life members. The treasurer's report shows a credit balance of over $2,000, in the face of a considerable expenditure for the *Transactions* and the *Bulletin*.

The following papers were read at the February meeting:

Dr. E. V. HUNTINGTON: 'A complete set of postulates for the theory of absolute continuous magnitude,' 'Complete sets of postulates for the theories of positive integral and positive rational numbers,' and 'A simplified definition of a group.'

Dr. M. B. PORTER: 'On the arithmetic nature of the zeros of Bessel functions.'

Dr. W. B. FITE: 'On a property of groups of order p^m.'

Professor L. E. DICKSON: 'The groups of Steiner in problems of contact.'

Dr. VIRGIL SNYDER: 'On the forms of quintic scrolls.'

Mr. PERCIVAL LOWELL: 'On the capture of comets by Jupiter.'

Mr. H. L. RIETZ: 'On primitive groups of odd order.'

Professor MAXIME BÔCHER: 'On systems of linear differential equations of the first order.'

Dr. E. J. WILCZYNSKI: 'Covariants of systems of linear differential equations.'

Professor JAMES MACLAY: 'On some associated surfaces of negative curvature.'

Professor E. W. BROWN: 'On the small divisors in the lunar theory.'

Mr. OTTO DUNKEL: 'Some applications of Green's theorem in one dimension.'

Mr. J. W. YOUNG: 'On a certain group of isomorphisms.'

Dr. A. S. Gale: 'On the rank, order and class ct algebraic minimum curves.'

Mr. W. H. Roever: 'Brilliant points and loci of brilliant points.'

At the close of the regular program Professor A. G. Webster gave a résumé of a paper, also read before the American Physical Society, on 'The Motion of a Spherical Pendulum,' illustrating it with photographs and stereopticon views.

The next meeting of the Society will be held on Saturday, April 26. The Chicago Section will meet at the University of Chicago on Saturday, March 29.

F. N. Cole,
Secretary.

MEETING OF THE NEBRASKA ACADEMY OF SCIENCE.

The twelfth annual meeting of the Nebraska Academy of Science was held the 24th and 25th of January, 1902, at the University of Nebraska, Lincoln, Nebraska.

The President's address, given by Professor E. W. Davis, was upon the subject, 'The Numerical Basis of Induction'; the remainder of the program being composed of the following papers:

'A Method of Instruction in Crystallography,' by Professor E. H. Barbour, in which he described an original method of instruction by the use of paper models to illustrate the extension of the faces; and plaster of Paris models, to allow of cutting in various planes, in which may be imbedded strings to show the position of the axes. He also showed apparatus for casting the latter.

'Preliminary Notice of a Bacterium Associated with Apple Rot,' by Mr. P. J. O'Gara, a review of experiments tending to show that rotting of apples is due to bacilli hitherto undescribed.

'Some New Properties of Conics,' by Dr. Carl C. Engberg, in which he illustrated some new facts bearing upon the transformation of well-known curves into other curves in accordance with certain assumed conditions.

'Report of Progress of the Nebraska Geological Survey': Professor E. H. Barbour.

'The Quadrat Method in Phytogeography,' by Dr. F. E. Clements, in which the author described the way in which this method was applied and gave some curious results of an attempt to estimate plant population under certain conditions.

'A New Bat Parasite,' by J. C. Crawford, Jr., being a description of a new genus and species belonging to the family Hippoboscidæ which has hitherto only been reported in North America from New Mexico.

'The Fossil Bryozoa of Nebraska,' by Professor G. E. Condra, in which he stated that the total number of species known for the State was 51, of which a score were hitherto undescribed.

'On a New Form of Psychrometer,' by Mr. John Fossler, in which he described a form of psychrometer in which the thermometers were rotated about a vertical plane with such a small radius that the apparatus could be used in a very limited space without at the same time any loss in accuracy.

'New Bird Lice from Nebraska': M. A. Carriker, Jr.

'Notes on North American Bees': J. C. Crawford, Jr.

'Nebraska Water Mites': Dr. R. H. Wolcott.

The last three papers were entirely systematic, containing descriptions of new species, together with records of occurrence, and in the case of the last paper also a table for the separation of species and such biological data as would present a complete view of what is known of the hydrachnid fauna of the State.

'Some Observations on the Buried Rock Surface of Eastern Michigan': Dr. C. H. Gordon.

'On the Use of Closed Aquaria in Schoolrooms,' by Professor Haven Metcalf, in which the author also gave hints on what could be grown, where and how to gather it and the best methods of cultivating the same.

'Some Remarkable Fossil Shark's Teeth from Nebraska,' by Professor E. H. Barbour and Carrie Barbour, in which the authors called attention to some teeth of *Campodus* and other sharks much more perfectly preserved than any hitherto found.

'The Strength of Nebraska-grown Catalpa and Osage Orange,' by Professor G. R. CHATBURN, a paper of considerable practical importance for the suggestions made as to the properties of the woods named for various economic purposes.

'Progress of the State Botanical Survey': Dr. ROSCOE POUND.

'The Present Knowledge of the Distribution of *Daimonelix*,' by Professor E. H. BARBOUR, detailing the great extension in range of this curious fossil which has resulted from the work of the State and national geological surveys, together with researches carried on by private individuals in Nebraska and adjoining States.

'Some Recent Changes in the Nomenclature of Nebraska Plants,' by Professor C. E. BESSEY, these changes being rendered necessary by the modifications of nomenclature introduced in recent botanical text-books.

'Relative Humidity in Dwelling Houses,' by Professor G. A. LOVELAND, giving the results of experiments upon the humidity of houses heated by various means, and the results of experiments with various expedients to increase the degree of moisture.

'A New Form of Sunshine Recorder,' by Professor G. D. SWEZEY, describing an instrument capable of registering not only the total amount and hours of sunshine during the day, but also varying intensity.

'Suggestions for a Revision of *Alysidium*': Dr. ROSCOE POUND.

'Preliminary Table of the Described Species of *Andrena*': Professor L. BRUNER.

'Some Observations on the Leeches of Nebraska': Professor HENRY B. WARD.

The last three papers were largely systematic.

'Plant Formations of Colorado': Dr. F. E. CLEMENTS.

'Some Experiments on the Paving Bricks of Nebraska': Mr. C. A. FISHER.

'Discovery of the Laramie Cretaceous in Nebraska,' by Mr. C. A. FISHER, in which he called attention to observations which extended the formation over the Wyoming line into Nebraska.

'Notice of certain fine Selenite Crystals from Cedar County, Nebraska': Professor G. E. CONDRA.

Forty-five members of the Academy were in attendance and an unusual amount of interest manifested. The secretary reported on the publication of Vol. VII. of the Proceedings, being a volume of 170 pages and 15 plates, which had recently come from the press, and also upon the plans for the immediate publication, as Vol. VIII., of the proceedings of the present meeting.

Forty-four new members were elected and the following officers decided upon for the ensuing year:

President, Professor J. H. Powers, Doane College, Crete; *Vice-President*, Professor H. B. Duncanson, State Normal, Peru; *Secretary*, Dr. R. H. Wolcott, State University, Lincoln; *Treasurer*, Professor G. A. Loveland, United States Weather Bureau, Lincoln; *Directors*, Mr. William Cleburne, Omaha; Dr. C. H. Gordon, Lincoln; Professor A. A. Tyler, Bellevue College, Bellevue; Dr. A. S. Von Mansfelde, Ashland.

The Academy passed resolutions commendatory of the United States Hydrographic Survey, and also resolutions endorsing the proposal to establish tree-planting reserves in Cherry County, Thomas County and in Grant and Arthur Counties in the sand-hill region of the State.

After the transaction of other minor business the Society adjourned for one year.

ROBT. H. WOLCOTT,
Secretary.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

AT the 547th meeting, held February 15, 1902, Dr. A. L. Day continued his paper begun at the previous meeting. He reviewed briefly the history of high temperature measurement from the Wedgewood clay pyrometer (1782) down to the most modern mechanical, electrical and optical methods. The interesting development of gas thermometry was treated in some detail; the remarkable early measurements of Prinsep, Pouillet and Becquerel with the more perfect gases and metallic bulbs; the hardly less remarkable, but unfortunate, experiments of Sainte-Claire Deville and Troost with iodine vapor in porcelain bulbs, which led pyrometric measurement in the wrong direction for so many years; the extensive and nearly simultaneous researches of Dr. Barus in the Geological Survey and Holborn and Wien in the German Reichsanstalt; and finally the successful return to first principles at the Reichsanstalt, with the help of the electric oven and the experience of the long line of distinguished predecessors, in which the speaker himself had a part.

The various methods for carrying pyrometric measurement beyond the range of the gas thermometer by making direct comparisons with it as far as it is available, and extrapolating the empirical relation thus obtained, were then taken up; Violle's calorimetric method, by which he obtained the results generally accepted for twenty-five years or more; the electrical resistance method (Siemens, Callendar and others), depending upon the variation in the resistance of a platinum wire with the temperature; the thermoelectric method (Barus, Holborn and Wien, and others), depending upon the electromotive force developed in a pair of wires (*pt* 90 *rh* 10—*pt* 10 usually) whose junctions are maintained at different temperatures; and several others. In closing, some recently published optical methods were reviewed (Berthelot, Lummer, Holborn and Kurlbaum) which promise to extend the upper limit of measurable temperatures almost indefinitely though with what accuracy, in view of the extent of the extrapolation necessary, it is hardly possible yet to say.

Dr. Day gave as the approximate limit of accuracy of the best methods now available $\pm 1°$ up to $1000°$, $\pm 10°$ to perhaps $1600°$, $\pm 100°$ to $3000°$ or more. He did not consider that the limit had been reached either in the accuracy or range of pyrometric measurement or even of gas thermometry and expressed regret that no more attention was being paid to so promising a field in this country.

Dr. L. A. Bauer presented a paper on 'Energy and Entropy: Their Rôle in Thermodynamics and Thermochemistry.' As suggested by the title, the respective rôles played by the two fundamental principles of thermodynamics, the principle of the conservation of energy and the principle of the increase of entropy, were set forth and elucidated by examples. It was shown that as much is known about the physical properties of entropy as of energy, and that in the phenomena of heat the entropy principle first comes into play, prescribing the direction or method in which stable equilibrium can take place. After the state of equilibrium has been reached then the principle of energy can be applied. It was shown that it would be a gain, now that the entropy function has been found, to discard the historical method of establishing the entropy principle and instead adopt a method similar to that followed by Hertz with regard to the fundamental equations of electromagnetism—*i. e.,* begin with an equation expressing a relation between the specific heats at constant pressure and at constant volume which admits of experimental proof and which prescribes that the entropy function has the same essential property as energy, viz., of being independent of the path or process used in going from one state to another.

A relationship between entropy and the term introduced by Helmholtz—*wärmegehalt,* changed by von Bezold to *potential temperature* and used by him extensively in his paper on the 'thermodynamics of the atmosphere,' was established and the name *entropic* temperature in place of *potential* temperature suggested.

Charles K. Wead,
Secretary.

DISCUSSION AND CORRESPONDENCE.

AGRICULTURE AND THE EXPERIMENT STATIONS.

The agricultural experiment stations of the United States, which the Federal Government has established in the several States, have now themselves passed the experimental stage and have to a remarkable degree won the respect and confidence of the farming and allied interests which it is their function to serve. There are at present fifty-nine experiment stations more or less completely maintained by Federal funds, two of which are colonial, and one of which is in Alaska. The organization and location of the continental stations affords an interesting example of the effect of the application of political conceptions to scientific investigation.

Agriculture is simply the business of growing plants and selling their products, either directly in the form of crops or indirectly in the form of the animal body into which they have been converted.

Affecting this are soil and climatic conditions, the market, the farmer's knowledge of the plants he grows and of the best methods for marketing their products.

None of these factors has anything to do with state boundaries. The fact that wheat is grown in a certain state is of no more, nor indeed of as much, significance as the fact that it is grown along a certain line of railway. A State boundary is a fiction of some political, but of absolutely no scientific importance whatever. A range of mountains or a river, on the other hand, is of tremendous significance so far as its effect on plant life is concerned. The northern and southern boundaries for a state like Kansas, two hundred miles wide, may be of some importance scientifically, as representing whatever differences in fauna or flora may be found resulting from the rather slight difference in the mean annual temperature of the two regions. But from the standpoint of scientific agriculture there is not a tithe of the significance in such a difference north or south from the center of this State as in the two hundred miles east or west of that point. Still more strikingly is the same fact exemplified in the states of Oregon and Washington.

The significant thing to know is not whether a given crop can be raised in the state of Oregon or in the state of Washington, but whether it can be raised in the region east of the Cascades, where there is a small annual precipitation and great evaporation, or west of the mountains where the reverse is true.

What does it convey to a scientific mind to say that such and such varieties of wheat are best for Ohio or Nebraska, when regional or climatic conditions within these states may furnish areas which demand wheat varieties of the most diverse character? Politically a state is a plane surface, holding a certain number of inhabitants subject to exactly the same civil laws.

Scientifically regarded, a state is an arbitrary block of territory chopped out at random, sometimes consisting of some vast physiographic domain of mountain, forest or prairie, sometimes comprising portions of all these within its imaginary boundaries.

One would naturally suppose that in the location of agricultural experiment stations, the points alone considered would be physiographic and meteorological ones. For scientific purposes, for example, one station in the western fourth of any one of those portions of the earth's surface called North Dakota, South Dakota, Nebraska or Kansas could more efficiently solve the problems of that whole vast region than can the present four stations, each of which is located outside of the high plains area, and in the eastern part of its geographic fiction, the state, which represents in each case in the eastern and western portions, such opposing facts of climate and topography.

One would naturally suppose that a geographical area of 62,000 square miles, of such very similar conditions as regards soil, climate and physiography as are found in the New England states, would scarcely need be provided with as many stations for experiment in agriculture as the region of 262,000 square miles which we call Texas, and which contains such diverse climates as are found in the humid tropical region of Brownsville, the desert tropical of El Paso, and the high, cool, semi-arid area of the Staked Plains. Yet we find six stations in the former and one in the latter geographic area.

The inconsistency involved in the absurdly unscientific location and distribution of our experiment stations is seen at a glance on a map of the United States having the stations prominently marked. Two stations dominating similar areas so far as agriculture is concerned, and of necessity dealing with precisely the same problems are found located ten miles from each other. But because they are in the separate 'states' of Idaho and Washington, it occurs to nobody to be an economic waste, as it certainly would if the neighboring boundary line were moved ten miles east or west, thereby throwing them into the same 'State.'

The location of stations within seventy miles of each other and in the midst of similar areas impresses no one as useless, so long as it is known that one is in Wyoming and the other in Colorado.

This fundamental error involved in the establishing of one of the United States experiment stations in each state, regardless of the facts of climate, soil or physiographic aspect, which may make a unit of several states for the purposes of agricultural experiment or may subdivide one state into several wholly distinct areas so far as plant life is concerned, must necessarily be responsible for a lesser efficiency to the country in proportion to the number of stations established than would exist if locations had been settled upon by a committee of scientific experts, without any regard whatever to state boundaries.

In other words, the quasi-dual nature of the experiment stations, receiving as they do their support from the Federal Government while their allotment is to the states as such, to which are also left the direction and control of the experimental work, together with the appointment of their staffs, results in a regrettable lack of coordinated and economically directed work. It would seem that experiments in agriculture in the various agricultural areas of the country would be conducted to much better advantage, if all the operations of the Federal experiment stations were planned, directed and controlled directly by the Department of Agriculture at Washington. This, in fact, is the only way in which the faults of indirection and of duplication of work could well be avoided. Under the control of the Federal Government, the problems of each agricultural area could be assigned to such stations as were best fitted to deal with them, instead of their energies being distributed vaguely over a variety of subjects, more or less intermittently and at haphazard, as local influences or the curiosity of the individual investigators dictate.

One of the great difficulties with experiment station workers at present is the isolation in which they labor, and the limitations of their outlook upon agricultural problems in general, due to the intense localization of their work and thought. This cannot well be otherwise, as lack of funds precludes them from the travel necessary to gain a knowledge of the work of other experiment stations, and the conditions of other agricultural regions.

If the experiment station staffs were filled by civil service appointment from Washington, and a system of transfers from station to station and back to Washington were made possible, it would seem that the resultant increased breadth of view, and more comprehensive grasp of the problems of scientific agriculture would inure greatly to the benefit of the whole country. By such a system of transfers the right man to attack any given problem could be detailed, at any time, to any experiment station in the United States, while by a civil service system of appointments a constantly higher standard of efficiency than now prevails could be insured everywhere.

At the present time a tendency seems to exist, if one station makes a reputation for itself in any one line of experiment, for others in the neighborhood to be stimulated to emulate, and if possible to excel, its efforts, due to the influence of state pride or rivalry. A duplication of work here occurs which is often wasteful and useless.

Under a Federal system of control a given problem might oftentimes be divided and assigned in part to three or four stations working coordinately. The advantage of such an assignment in the case of many experiments is sufficiently obvious.

One of the difficulties in the way of the highest efficiency on the part of experiment station workers lies in the association of the experiment stations with the state educational institutions, and the combination of the duties of a teacher in one of these with those of an investigator in the experiment station. As a matter of fact, the work of the teacher and the investigator cannot be wholly divorced, but oftentimes by far the greater part of the time of the experiment station men is swallowed up in the details of college duties, to the serious detriment, of course, of the work of the station. The absolute separation of the federal station workers and the state agricultural college workers, so far as their duties are concerned, need not prevent the chemist of the station from doing some teaching in soil chemistry for example, or the professor of botany of the college from taking advantage of the work and, so far as possible, sharing the interests of the botanist of the experiment station.

The main necessities then for the increased efficiency of our agricultural experiment stations would seem to be:

1. A centralized management, with the direction and distribution of all experimental work left to a single board of control, preferably to be connected with the United States Department of Agriculture.

2. A system of civil service appointments to positions in all Federal stations, and an elasticity in the organization of the different staffs, making possible the transfer of scientific workers from one station to another according to the judgment of the governing board.

3. The complete separation of the experimental research work of the station investigators and the pedagogical work of the college teachers of science in localities where the experiment station is located on the grounds of a state institution. This would necessitate an increased salary roll in both the college and station, but would increase the working efficiency of both in a far greater ratio.

H. F. ROBERTS.

KANSAS STATE AGRICULTURAL COLLEGE.

INJURIES TO THE EYE, CAUSED BY INTENSE LIGHT.

MR. FRANK ALLEN'S observations in these columns (January 17, 1902, p. 109) suggests an experience of my own which is worth recording in some detail.

Last April I ran the projection lantern one evening for a friend, the exercise lasting nearly two hours. The lantern is an arc lamp, hand feed, and the current was giving some trouble. The arc had to be kept rather short, and it was necessary to look in at the arc very often. To guard my eyes from the glare, I had three thicknesses of blue glass in front of the arc. Yet I noticed that my eyes were being injured. At the close of the lecture there was a distinct dimness in the center of my field of vision. This has often happened after looking at a bright light, and I thought nothing of it. Next morning, however, my neighbor at breakfast wore a bright yellow rose, and I noticed a distinct spot of pink on it, yet on examining it closely there was no pink, or at least only a trace of pink in the center of vision. At a distance of six feet the whole rose was pink.

On the street that morning, an orange peel on the walk at a distance of twelve feet was bright red; on a nearer view only a central spot was red. And every yellow house had a pink spot, and every orange surface a red one from that time on. Then I saw that in reading there was a gray area on the page in the center of vision.

It was plain that focusing so long on the arc through the blue glass had paralyzed or killed the cones in the *fovea centralis* and its immediate vicinity—that is, such cones as normally respond to the short waves at the blue end of the spectrum. So my eyes in that area of the retina responded only to the longer or red waves from the rose or the orange, and in ordinary vision I was deprived of just that much illumination.

This condition persisted in a very striking way all summer, but gradually disappeared in the autumn, and now, at the end of ten months, I can discover no trace of the dimness in the center of vision, nor can I see any trace of pink in a yellow surface. So whatever the disability was, it has been overcome. If the cones were destroyed, they have been replaced; and if only paralyzed, they have resumed their normal function.

J. PAUL GOODE.

THE UNIVERSITY OF PENNSYLVANIA.

A GEOGRAPHICAL SOCIETY OF NORTH AMERICA.

TO THE EDITOR OF SCIENCE: Referring to the very interesting letter from Professor W. M. Davis (SCIENCE, XV., No. 373, p. 313, February 21, 1902), there seems to be no reason why the aims of the professional geographer should exclude any non-professional who is anxious to keep in touch with the latest advances in geographical knowledge.

Their need is apparently mutual. The professional should be glad of all the support, moral and financial, which he can secure throughout the community, while there are many students who wish to keep advised of all progress as it is made.

Let the 'professionals' constitute the 'members' of the Society and let the test for 'membership' be as rigid as may be found necessary, so that being a member shall constitute *prima facie* evidence to the world of established professional ability and experience.

Let there also be a class of 'associates,' who shall include any respectable person of legal age (duly elected) who desires to join and is willing to pay the established dues.

All members should be elected as associates and any associate should have at all times the privilege of applying to a 'board of examiners' for election to full membership.

This course of procedure has been found satisfactory in the American Institute of Electrical Engineers and in other engineering bodies. It preserves to the professional all the honor and exclusiveness which he can desire, yet serves to draw into a compact and powerful organization all who for any reason wish to keep in touch with the most recent advances.

Such an inclusive policy would seem to be the wise course for all of our scientific societies, each of which is supposed to exist for the purpose of educating the public at large and of arousing a widespread interest in its specialty as well as for the benefit of its professional members.

J. Stanford Brown.

New York City.

THE PHYSIOLOGICAL EFFECTS OF THE ELECTRICAL CHARGE OF IONS.

In No. 374 of Science Professor Lee gives a review of the Chicago meeting of the American Physiological Society in which he says that I 'maintained that vital phenomena, in general, are caused by the electrical charges of ions.' I wish to state that I have never held nor expressed such an opinion.

Jacques Loeb.

The University of Chicago,
March 3, 1902.

NOTES ON INORGANIC CHEMISTRY.

In proposing the toast, 'The Houses of Parliament,' at the annual dinner of the fellows and associates of the Institute of Chemistry held in London last December, Professor Ramsay referred to the recent jubilee of Professor Berthelot in Paris and the cooperation of the French government with the scientific societies in honoring the distinguished chemist. He then said that while the British government often has occasion to take the advice of scientific experts, it does not as a rule honor science generally in the persons of those who have most distinguished themselves, as is done in many other countries. He called attention to the work of the chemists of the United States Geological Survey, and regretted that this example is not followed by the Geological Survey of Great Britain. Touching upon the question of water supplies, he gave it as his opinion that, valuable as the bacteriological examination of water is, it must be looked upon as merely confirmatory of the examination of the chemist. In responding to this toast for the House of Commons, Mr. Hanbury remarked incidentally that science would be of incomparably more practical value if its 'hideous terminology' could be done away with.

The question of the existence of the ammonium radical, NH_4, has been very exhaustively studied by Moissan, whose results are published in the *Comptes Rendus* and in the *Archives Néerlandaises.* His methods included the electrolysis of ammonium chlorid and ammonium iodid in solution in liquid ammonia, the examination of ammonium amalgam at a temperature as low as —90°, where the amalgam is perfectly stable, and the action of liquid hydrogen sulfid on lithium-ammonium and calcium-ammonium at —75°. In none of the experiments was any evidence of free ammonium found, incidentally confirming the recent results of Ruff. Moissan believes, however, that under some circumstances a hydrid of ammonium, NH_4H, is capable of existence.

The passivity of iron has been studied from the standpoint of physical chemistry by Finkelstein. Determinations of its polarization capacity and resistance indicate that there can be no coating of badly conducting oxid on the iron, as has been assumed by some observers. The conclusion is drawn that the surface of passive iron consists solely of trivalent iron, the formation of passive iron by oxidizing agents and by electrolysis being due to the replacement of bivalent by trivalent iron.

The subject of the action of water upon metallic lead is one that has been much studied, and the results of different observers have been by no means concordant. A recent extended investigation by Stanislav Růžička furnishes results which are not wholly in accordance with the generally received ideas. His method was to place bright lead in cylinders containing various solutions, insert a stopper and leave the whole for twenty-four hours. The amount of lead in the solution was then estimated. Care was taken to ensure the absence of air. Nitrates, chlorids, sulfates and carbonates of alkalies and alkaline earths were studied, and also various organic substances. Among his conclusions are the following: The action of salts is wholly independent of the base, and is proportionate to the solubility of the lead salt of the acid of the salt used. Thus nitrates have the most action, chlorids next, sulfates next and carbonates least. The action of the first-mentioned salts is diminished by the presence of carbonates in the water, while the addition of a nitrate increases the action of other salts. If the same piece of lead is exposed to fresh solutions of the carbonate, the action is much diminished, and the same diminution occurs even in the presence of nitrates and free oxygen. Free carbon dioxid greatly diminishes the action of water or salt solutions on lead, while air in all cases increases it. Infusions of grass leaves diminish the action of water, while it is greatly increased by infusion of peat.

A recent number of the *Mineralogical Magazine* contains a paper by J. W. Evans on the action of ground-water on pyrites, a study called forth by the building of a reservoir in northern Mysore. It was feared that the large quantity of pyrites in the underlying rock would act harmfully on the water. It was found that when the water was free from carbonates the pyrites are very slowly acted on with the formation of iron sulfate. On the other hand, when carbonates are present iron carbonate, hydroxids and oxids are to be expected, the hydrates being first formed. Free carbon dioxid in the water seems to be without effect. In the presence of pure water, metallic arsenids are changed into arsenates, which are generally insoluble, and the presence of carbonates has merely the effect of retarding the change.

In an examination of Oriental medicines, P. Guigues had occasion to test a sample of 'Zerquoun minium,' which is used as a rather expensive substitute for the red oxid of mercury. The specimen resembled red lead, but had a lower specific gravity. On treatment with water a white sediment and a red solution were obtained. The former proved to be a magnesium silicate and the red substance a coal-tar dye, revealing the fact that adulterations are not peculiar to the Occident.

The above recalls the fact that the writer came into the possession some years ago of a specimen of Chinese medicine held in high esteem, which, it was supposed, was prepared from urine by some intricate method. Examination showed it to be ordinary salt, and of so pure a quality that it was hardly conceivable that it had been prepared from its reputed source.

J. L. H.

CURRENT NOTES ON METEOROLOGY.

MAURITIUS METEOROLOGICAL SOCIETY.

It is a pleasure to note that the Meteorological Society of Mauritius has taken a new lease on life. This Society, with which the late Dr. Charles Meldrum was so closely associated, has in the past been active in promoting a study of the cyclones of the South Indian Ocean, to which study Meldrum devoted a large share of his time for about forty years. The successor of Dr. Meldrum as director of the Royal Alfred Observatory and also as secretary of the Meteorological Society of Mauritius, is Mr. T. F. Claxton, F.R.A.S., who is evidently doing much to arouse interest in a society which the honored traditions of the past should most certainly keep alive and active. In the *Proceedings of the Meteorological Society of Mauritius* for 1901, Mr. Claxton has some 'Remarks on the Objects for which the Meteorological Society of Mauritius was Established.' In this paper it is shown that the work already accomplished has been most important, and the hope is expressed that the number of observing stations cooperating with the Royal Alfred Observatory may be increased. An unforeseen decrease in the number of vessels which call at the island of Mauritius has resulted in a corresponding decrease in the number of marine meteorological observations received by the Mauritius Observatory. The annual number of vessels has decreased from 787 in 1878 to 283 in 1900. The material for the daily weather maps is now so scanty that these charts have been discontinued except during cyclone weather, when they are useful for determining the tracks of cyclones. For giving a correct representation of the atmospheric conditions over the Indian Ocean, with a view to studying the sequence of weather changes, the charts are now well-nigh useless.

Vol. I. of a new series of the *Proceedings and Transactions of the Meteorological Society of Mauritius*, 1896–1900, has come to hand recently, and is welcome as a continuation of the older series, which was discontinued in 1864 for lack of funds and other reasons. This volume contains a number of interesting papers, chiefly on the cyclones of the South Indian Ocean from 1896 to 1900. A cyclone in February, 1896, passed centrally over Mauritius, this being the second case of this kind on record since the commencement of systematic observations in 1848. The diameter of the 'eye' was about twenty miles. Meteorologists will be glad to have in their hands these further contributions to the study of the Mauritius cyclones, and will not be slow to express their thanks to Mr. Claxton for his energy in continuing Meldrum's great work.

BRITISH RAINFALL.

The annual volume on 'British Rainfall' comes this year in its familiar blue cloth binding, but with a new name, that of Dr. Hugh Robert Mill, on its title page. As has already been reported in these 'Notes,' Mr. H. Sowerby Wallis succeeded to the editorship of this important publication after the death of Mr. George J. Symons in 1900. Mr. Wallis was associated with Mr. Symons for over thirty years, and from 1890 on his name appeared with that of Mr. Symons on the title-page of 'British Rainfall.' Dr. Mill, as already noted in these columns, has assumed the editorship of *Symons's Monthly Meteorological Magazine*, and is now associated with Mr. Wallis in carrying on the work of the British Rainfall Organization. The present volume is a particularly interesting one. Dr. Mill has a paper on 'The Ilkley Flood of July 12,' which was caused by an unusually heavy rainfall amounting to 5.40 in. at Ilkley itself (the maximum fall for the year in the British Isles); and another paper, of historic value, on 'The Development of Rainfall Measurement in the last Forty Years,' in which the material, size, form, exposure and elevation of rain gauges used in England are considered. It is a satisfaction to know that 'British Rainfall' is to be continued in such excellent hands.

CLIMATIC CONDITIONS OF PANAMA AND NICARAGUA.

In a recent paper on 'The Present Condition of the Panama Canal' (*Engineering Mag.*, January, 1902), Gen. H. L. Abbot considers briefly the climatic conditions of the Panama and Nicaragua canal routes. Throughout the entire region the temperature varies but little during the year from the annual mean of 79°. The high temperatures and high relative humidity forbid hard manual labor on the part of white men. The hospital records of the Panama Railroad and of the Canal Company during the past twenty years show that there is no reason for apprehending serious trouble from sickness in the future. At Colon the annual precipitation is about 129 inches, in the interior, about 94 inches, and on the Pacific coast, about 57 inches. There is a clearly defined dry season of about four months everywhere along the route of the Panama canal. This season can be used for especially difficult engineering operations. Furthermore, the heaviest work is in the interior, where the rainfall is not excessive. The conditions are less favorable in Nicaragua. Near the Gulf coast, where the heaviest excavations are required, the rainfall appears to be about 250 inches and there is no dry season. On the Pacific coast and in the interior there is less rainfall, and there is also a dry season. Even here, however, the rainfall seems to be somewhat greater than in the corresponding portions of the Panama district.

DAY DARKNESS IN LONDON.

A SHORT article of some interest in *Symons's Monthly Meteorological Magazine* for January concerns the number of hours during which artificial light was necessary in a London office (J. E. Clark, 'Day Darkness in the City'). The record has been kept since September, 1897, and runs through 1901. Office hours were from 9 to 5, and to 1 P. M. on Saturdays. A curve illustrates the diurnal distribution of dark quarter hours. There is a rapid rise from 9 to 10.15; then a marked fall to just before noon; then a slight rise; a fall after 12:30 until just before 1; a rise till after 1 and a steady and marked rise from about 2 on. The first rise is believed to be associated with the lighting of office fires. The noon rise seems to follow luncheon preparations in the restaurants, and that an hour later is thought to be due to the fact that lunching is then in full swing. The results of these observations are not without interest, but the explanation of the facts discovered on the basis of so few records cannot be accepted as at all convincing.

R. DEC. WARD.

SCIENTIFIC NOTES AND NEWS.

THE National Observatory question has assumed a new phase through the action of the secretary of the navy, in sending to Congress through the secretary of the treasury an estimate for the salary of a director of the naval (or national) observatory. The committees of Congress thus have the matter before them in a form in which it was never before presented, and it lies with Congress to decide whether it will accede to the recommendation.

PROFESSOR HERMON C. BUMPUS, formerly of Brown University, who has held during the past year the position of assistant to the president in the American Museum of Natural History, New York, was appointed director of the museum at the annual meeting of the board of trustees. This places the museum in the same position as regards administration as the Zoological Park and the Botanical Garden of New York. Morris K. Jesup was reelected president, William E. Dodge first vice-president, and Henry F. Osborn second vice-president.

PROFESSOR W. H. BREWER, for thirty-seven years professor of agriculture in the Sheffield Scientific School of Yale University, will retire from the active duties of the professorship at the end of the present academic year.

DR. J. KINYOUN, who has for fifteen years been connected with the U. S. Hospital Service and is at present commanding officer and chief surgeon of the hospital at Detroit, has resigned from the service.

MR. ALEXANDER AGASSIZ has had a portrait of himself painted by M. Jules Lefevre. The painting in which he is shown in the robe of members of the Paris Academy will be presented to Harvard University.

M. ANDRÉ, of Lyons, has been elected a correspondent of the Paris Academy of Sciences in the Section of Astronomy in the room of the late B. A. Gould.

THE Zoological Society of London will confer its gold medal on Sir Harry Johnston, whose remarkable discovery of the okapi has recently attracted so much attention, and its silver medal on Mr. E. W. Harper, of Calcutta, who has given many rare Indian birds to the society's collections.

SIR JOHN S. BURDON-SANDERSON, professor of physiology at Oxford University, has been given the degree of Doctor of Science by Owen's College, Manchester.

THE University of Jena has awarded and conferred an honorary doctorate on Herr Wilhelm Winckler, in recognition of his astronomical researches.

Dr. C. S. Belli, of Turin, has been appointed director of the Botanical Gardens at Cagliari.

Dr. A. A. Ivanov, assistant astronomer at Pulkova Observatory, has been appointed inspector in the St. Petersburg Institute of Weights and Measures and at the same time has been made docent in astronomy and geodesy at the University.

At the anniversary meeting of the Geological Society of London officers were elected as follows: President, Professor C. Lapworth, F.R.S.; Vice-Presidents, Sir Archibald Geikie, F.R.S., Mr. J. E. Marr, F.R.S., Professor H. A. Miers, F.R.S., and Professor H. G. Seeley, F.R.S.; Secretaries, Mr. R. S. Herries and Professor W. W. Watts; Foreign Secretary, Sir John Evans, F.R.S.; Treasurer, Dr. W. T. Blanford, F.R.S. The medals and funds were awarded in accordance with the announcement that we have already made.

M. Berthelot has been elected honorary president, and M. Moissan, president, of the council of the Chemical Society of Paris.

M. Teisserenc de Bort has made a visit to Denmark to establish a meteorological station in which kites and captive balloons will be used.

Professor Bessey, of the University of Nebraska, is to give a course of twenty lectures on botany in the Colorado Springs Summer School, which is to be held in Colorado Springs, Colo., in July and August.

Professor Volney M. Spalding, of the University of Michigan, is at present on a botanical expedition to Florida.

Major Ronald Ross, of the Liverpool School of Tropical Medicine, left Liverpool on February 22 for Sierra Leone to make an examination of the drainage scheme being carried out there, and to study the health of the natives.

The committee of the Medical School of the Johns Hopkins University, appointed to erect a memorial to the late Jesse William Lazear, who lost his life as the result of an experiment on the transmission of yellow fever by mosquitoes, reports that sufficient money has been subscribed to erect a memorial tablet and to establish a library fund for the purchase of works relating to tropical diseases. The committee now hope that a sufficient sum may be subscribed to establish a permanent scholarship for the study of tropical diseases. Subscriptions for this purpose may be sent to Dr. Stewart Paton, treasurer, 213 West Monument Street, Baltimore, Md.

Professor Leo Königsberger, of Heidelberg, is preparing an extended biography of Hermann von Helmholtz, which will be published by Friedrich Vieweg and Son.

The students of the University of California held memorial exercises in honor of the late Professor Joseph Le Conte on February 26, the anniversary of his birth. An address was made by Professor Thomas R. Bacon. The students of the university are collecting funds to assist in the erection of a granite lodge which the Sierra Club proposes to construct in the Yosemite Valley as a memorial to Dr. Le Conte.

Dr. Christian Penger, professor of clinical surgery in the Rush Medical College of the University of Chicago, died on March 7, at the age of fifty-two years.

We regret to record the following deaths among foreign men of science: Dr. Emil Holub, a distinguished African traveler, in Vienna on February 21, aged fifty-four years; Professor Moriz Kaposi, of the University of Vienna, well-known for his publications on diseases of the skin, on March 6, at the age of sixty-four years; Dr. Carlos Berg, director of the National Museum at Buenos Ayres, at the age of fifty-nine years; Dr. Johannis Pernet, professor of physics in the Polytechnic School at Zurich, at the age of fifty-seven years, and Captain Gaetano Casati, an Italian explorer who spent ten years in Africa, at the age of sixty-three years.

At the annual meeting of the Board of Managers of the New York Zoological Society it was reported that the society has contributed $250,000 towards the Zoological Park and has $18,000 in the treasury yet to expend, in addition to $17,000 which has been expended upon the plans and designs for the buildings. The City of New York has expended $425,000 in the general development of the park, and in the erection of a monkey house and lion house. The latter building will be open to the public in September next. During the past year a medical staff has been established in order to secure scientific treatment of the animals and to study the causes and prevention of diseases. This consists of Dr. Frank H. Miller, a veterinarian of European training; Dr. Howard Brooks, a well-known pathologist, and a laboratory assistant. A number of interesting facts have already been secured by this staff which will be reported later in SCIENCE. The Society has applied to the Board of Estimate and Apportionment for an additional sum of $500,000, to be expended in the development of the physical features of the park, in forestry, and also in the construction of additional buildings, especially the antelope house, ostrich house and a larger bird house.

As we have already announced, the seventy-second annual meeting of the British Association for the Advancement of Science will be held at Belfast, beginning on September 10. Professor James Dewar is the president-elect, and the presidents of the sections are as follows: Mathematical and Physical Science, Professor John Purser; Chemistry, Professor Edward Divers; Geology, Lieutenant-General C. A. McMahon; Zoology, Professor G. B. Howes; Geography, Col. Sir T. H. Holdich; Economic Science and Statistics, Mr. E. Cannan; Engineering, Professor John Perry; Anthropology, Professor A. C. Haddon; Physiology, Professor W. D. Halliburton; Botany, Professor J. Reynolds Green; Educational Science, Professor Henry E. Armstrong. Professor Dewar's presidential address will be given on the evening of September 10; on September 11 there will be a soirée; on the evening of September 13 a discourse on 'Becquerel Rays and Radio-Activity' will be delivered by Professor J. J. Thomson; a lecture will be given to the operative classes on September 14 by Professor L. C. Miall; on Monday evening, September 16, a discourse on inheritance will be delivered by Professor W. F. R. Weldon, M.A., F.R.S.; on Tuesday evening there will be a soirée; on Wednesday, September 18, the concluding general meeting will be held at 2:30 P.M.

LETTERS dated from Franz Josef Land, August 17, have been received at Copenhagen from members of the Baldwin-Ziegler Arctic expedition which left Tromsöe, Norway, on July 16, last year, on the steamers *America* and *Belgica*. The vessels arrived at Franz Josef Land, after trying experiences, with all on board well. The *America* intended to winter at Franz Josef Land, and then proceed northward until stopped by the ice, when the party on board of her was to start towards the North Pole. Mr. Baldwin hoped that the *America* would reach 83 degrees north.

AT a meeting of the Royal Geographical Society, on February 24, Sir Clements Markham, president, described the progress of the British Antarctic expedition and laid special stress on the need of securing sufficient money for the relief ship which is to be sent out in June. Subscriptions for this purpose include: The Royal Society, £500; the Goldsmiths' Company, £200; Mr. L. W. Longstaff, £5,000; Miss Dawson-Lambton, £500; Miss E. Dawson-Lambton, £500; Mr. J. P. Thomasson, £500; Lady Constance Barne, £150; the Duke of Bedford, £100; Sir E. Cassel, £100; Mr. H. Leonard, £100; Dr. G. B. Longstaff, £100; Mr. Duncan Mackinnon, £100; the Duke of Northumberland, £100; and Mr. S. Vaughan Morgan, £75.

THE Royal Astronomical Society has received from Sir William Huggins a copy of the portrait of Galileo at Florence, and from Sir W. J. Herschel, a medallion in Wedgwood ware of Sir William Herschell.

THE council of the Royal Institute of British Architects has granted the sum of £50 to the Cretan Exploration Fund towards the completion of Mr. Arthur Evans's excavations at Knossos. Since the appeal issued in December the sum of £1,600 has been raised.

UNIVERSITY AND EDUCATIONAL NEWS.

PRESIDENT HARPER announced in his last quarterly statement that Mr. John D. Rockefeller gave on December 1, $1,000,000 toward the general endowment fund of the University of Chicago. Mr. Rockefeller has also given $250,000 to be used for the general needs of the University during the present academic year.

BY the will of Mrs. Lila Currier, $50,000 will go to Columbia University and $100,000 to Yale University upon the death of Mr. Edward W. Currier.

BY the opinion just handed down by the Supreme Court of Pennsylvania affirming the opinion of the Orphans' Court of Philadelphia, which sustained the will of the late Joseph M. Bennett, the University of Pennsylvania acquires real estate declared to be worth more than $500,000. The decedent left the property to the University 'to further aid and encourage the trustees in carrying out more practically and thoroughly the coeducation of women and girls.'

THE daily papers renew the reports that negotiations are under way for the amalgamation of the Armour Institute of Technology with the University of Chicago. The plan involves the removal of the Institute to the University campus, where the University will furnish buildings and equipment to the value of $1,000,000, while the Armour interests will give $1,500,000 in endowment. Subsequent gifts from the Armours and Mr. Rockefeller are expected to increase the capital of the technology school to $5,000,000. The school will continue to be known as the Armour Institute of Technology, its policy will be maintained, and the heads of departments will remain practically the same.

COLUMBIA UNIVERSITY has received an anonymous gift of $10,000 for two scholarships, and one thousand dollars for a course of biological lectures.

MR. WILLIAM JOHNSTON, a Liverpool shipowner, has given £25,000 to the University of Liverpool, to promote research in pathology and physiology.

A CHAPTER of the scientific honor society Sigma Xi has been organized at the University of California with twenty members of the faculty as charter members.

THE registration at the University of Chicago for the autumn quarter was 2,431, as compared with 1,961 in 1900 and 1,682 in 1899. The number of students in the graduate schools was 435, of whom 197 were in the Ogden school of science. In the school of arts and literature the numbers of men and women were equal, in the school of science there were 170 men and 27 women.

THE new laboratory building of the department of horticulture of the Iowa State College was formally opened on Saturday evening, February 22.

CABLEGRAMS report that in the disturbances on February 22, at Moscow University, four hundred students, armed with bludgeons, iron bars and revolvers, wrecked the interior of the University buildings, barricaded themselves within, and hung out red flags from the windows. The police and troops forced an entrance into the interior and arrested the ringleaders of the rioters. A decree of the minister of public instruction has been gazetted, ordering the expulsion from the University and high schools of all students arrested in connection with rioting.

PROFESSOR F. J. E. WOODBRIDGE, now head of the department of philosophy in the University of Minnesota, has been elected to the chair of philosophy at Columbia University vacant by the election of Dr. Nicholas Murray Butler to the presidency.

DR. GEORGE E. DE SCHWEINITZ, professor of ophthalmology in the Jefferson Medical College, has been elected to succeed the late Dr. Norris as professor of ophthalmology in the University of Pennsylvania.

DR. K. VON TUBEUF, chief of the biological division the German Department of Health, has been appointed professor of forestry in the University of Munich.

ERRATA.

THE following errors were overlooked in the proof of Professor Greenhill's paper (SCIENCE, XIV., p. 973, 1902): Eq. (1), for x read ψ p. 3, line 13, for δ read ϑ; eq. (19), for k read κ; eq. (28), for z^2 read z_2 and for $E-2$ read $E-z$; eq. (32) *et seq.*, for μ and v read u; eq. (40), for n read u.

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, MARCH 21, 1902.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE DISTRIBUTION OF VACATIONS AT AMERICAN UNIVERSITIES.

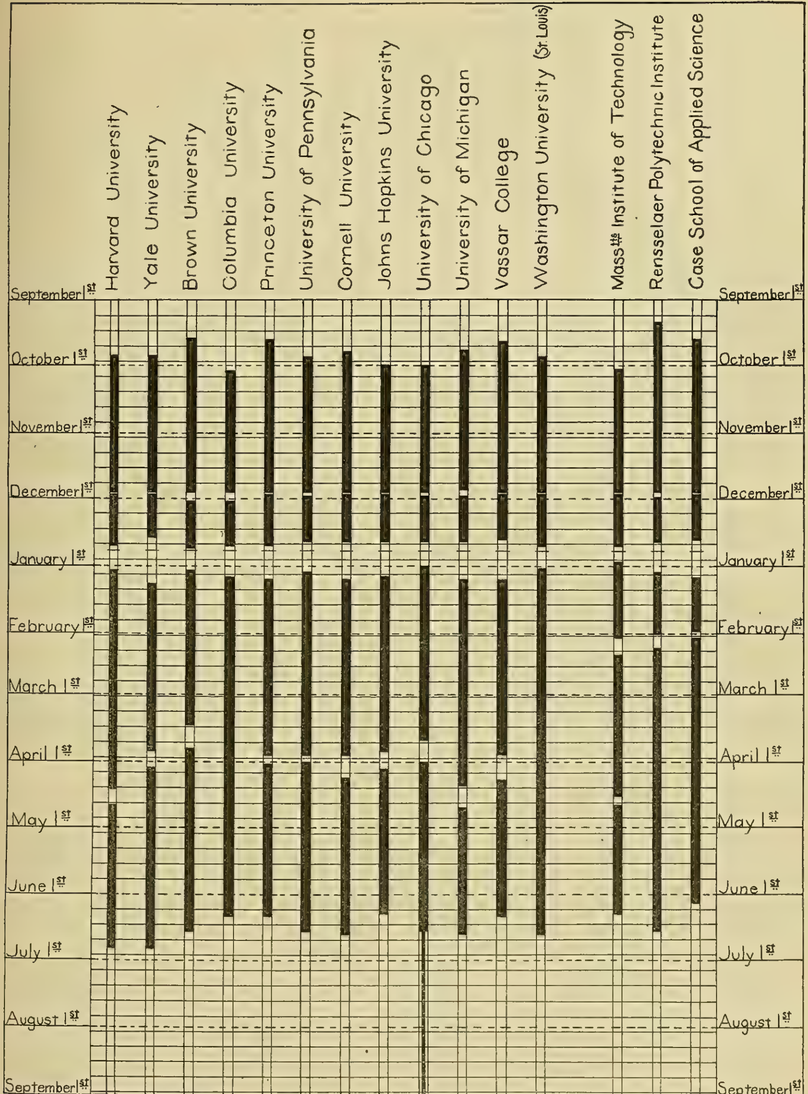
IN connection with the work of the committee appointed by the American Association for the Advancement of Science for the establishment of Convocation Week, it seemed desirable to gather some more accurate impression as to the periods of vacation now in vogue at our universities and colleges. It is very difficult from the reading of catalogues or even by the tabulation of days to gather a clear impression of the differences in the academic calendars of various institutions, so that, almost necessarily, resort was taken to a graphic representation of the facts. The accompanying diagram is perhaps sufficient to indicate the main conditions. In this diagram each vertical column represents the calendar year of one institution. The horizontal lines indicate divisions by weeks. The dotted lines indicate the first day of each month of the academic year from September 1, 1901, to August 31, 1902. In each vertical column the black spaces correspond to term time and the white spaces to vacations. As in every case Christmas falls in vacation time, its position is marked by a black line crossing each column. Fifteen institutions are represented in the chart; twelve universities and three technological schools. The selection has been made so as to have as representative a variety as possible.

Examination of the diagram shows at once the entire absence of any uniformity in the practice of our universities as to the make-up of their calendar. Each institution seems to be a law unto itself, and except that they all begin in the latter part of September or the earlier part of October; that they all have a Christmas vacation and that they all end the year's work in June, there is no uniformity of practice. But even within these broad limits there is great variety. Three of the universities, for instance, begin the third week in September; four begin the fourth week in September; and three the first week in October. In the duration of the Christmas vacation there is even greater proportionate variety, the length being from one week to three. In regard to spring vacations a still greater diversity occurs, some of the institutions having none, one having a considerable vacation in the middle of March, another having a considerable vacation in the middle of April. The length of vacation varies from nothing up to ten days. Equally conspicuous is the discordance of the time of closing the work of the year. The practice of Chicago University of partially continuing the work of instruction during the summer time differs from that of other universities, and this is indicated in the diagram by representing the summer period for that university as half black and half white.

An examination of these diagrams must, I think, convince every one that it is a practical problem for our universities to consider whether they should not aim at a greater or perhaps even a complete uniformity in the length of their term times and of their vacation times. There would be many advantages in this and it would be one of the factors which might contribute to facilitate the migration of students from one university to another. Now that we have an association of a number of the leading universities of the country, the machinery for the proper discussion of the length of the university terms already exists, and it is to be hoped that this association will take up the consideration of this problem, study it thoroughly and, if it seems expedient, introduce a reform in the practice as it now exists.

The national movement in favor of Convocation Week is distinctly in favor of uniformity in the distribution of vacations. It seems to me that the success of the movement in behalf of Convocation Week is complete and that all of our universities will ultimately conform their Christmas vacation to this new demand, as so many of our universities have already done.

Another fact which is very striking in a graphic representation is the very large proportion of time which is wholly given up to vacation. In this respect university students are privileged beings, having a degree of liberty, of exoneration from responsibility and work such as is accorded to young men in no other occupation whatever. In old times when our colleges had, not young men, but boys as students, this great amount of vacation was certainly justified as a measure for the protection of the health of growing boys. But why students of advanced years should be treated as if they were incapable of doing the amount of work which they would have to do if they went into any practical business or profession in life, is not clear. I think it may be safely said that from the standpoint of the benefit to students, the amount of university vacation is very excessive, and when we think how much our young men are now retarded when they go through college and still more if they go through a college and a professional school before they can enter on practical life, we must look upon the


Harvard University
Yale University
Brown University
Columbia University
Princeton University
University of Pennsylvania
Cornell University
Johns Hopkins University
University of Chicago
University of Michigan
Vassar College
Washington University (St. Louis)
Mass^tts Institute of Technology
Rensselaer Polytechnic Institute
Case School of Applied Science
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May 1st
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July 1st
August 1st
September 1st

great extent of vacation as an evil. With the vacation shortened it would be easily possible to bring these young men into active life at least a year earlier than is now possible, and that would be an immense gain.

From the professors' point of view the circumstances are very different. To few professors is the vacation time wholly a period of vacation. On the contrary, it is a time which he can utilize for study, for research and for the increase of all his mental equipment upon which his proficiency as a professor depends. Moreover there is often work upon examination papers or upon a committee of one kind or another, which the professor must carry on during the vacations while his students are idling. For the professor the vacation is certainly a great advantage and I think from the standpoint of university service it is an essential factor in maintaining his efficiency. If therefore the vacations are shortened, it seems to me that every university should provide additional liberty for its professors. The tendency has hitherto been rather to demand too much teaching from professors, but if they teach too much they cannot be qualified to teach in the best manner and with the greatest efficacy, because every professor, to remain efficient, must have time for study; he must advance, he must grow intellectually, and from mere teaching he can never grow.

A consideration of the circumstances therefore suggests these two thoughts: first, that for the benefit of the students the amount of vacation at our universities should be diminished; secondly, that if this is done, then, to preserve the efficiency of the professors, the amount of free time accorded them during term should be increased.

Charles S. Minot.
Harvard Medical School, March 5, 1902.

THE INTELLECTUAL CONDITIONS FOR THE SCIENCE OF EMBRYOLOGY.

I.

Much has been written, from time to time, about the conditions which must be fulfilled by a scientific account of the generation and regeneration of living things out of eggs, although little has been said about the intellectual conditions. We may, nevertheless, find the study of these conditions both interesting and instructive.

Our chief interest in embryology is the hope for a scientific account of ourselves; but we cannot undertake to account for anything unless we know what it is that we undertake to account for.

My purpose is not to give a scientific account of mind, nor to discount the future progress of science. I do not believe we are likely to know anything about the natural history of mind except what we find out by scientific discovery; nor do I believe we are ever likely to have a complete scientific account of anything, or to reach a point where no new discoveries are needed.

My purpose is a more humble one: to do what I can to keep the way clear for progress in embryology, by trying to free my own mind, and the minds of others, from all notions which imply that embryological science is impossible.

PART I. THE DOCTRINE OF THE CHASM.

The notion which, for reasons which will soon be made clear, I have called the doctrine of the chasm, is dry and difficult and unattractive, and as my only aim is to find a way for the embryologist across the chasms which are said to lie in his path, I have made no attempt to stimulate the interest of the reader, confining myself to the briefest outline which will serve my purpose, even if this outline be more arid than the works in which the doctrine of the chasm is defended.

1. *Among the things of which he hopes to, some day, give an account, the embryologist must include men who think and act.*

Of all the facts that are made known by experiments upon the generation and regeneration of living things, the one we are least likely to doubt is the existence of the experimenter. We may question the value of his results, but we are not likely to doubt that he did, or tried to do, or thought that he did, the things he describes.

The experimental embryologist comes out of an egg, and he must himself be included among the facts of development which are the object of the observations and experiments and reflections by which he seeks to account for the production of living things out of eggs.

Since some of the things that come out of eggs observe, and reflect, and try experiments, the production of living things out of eggs cannot be adequately explained, or accounted for, unless the production out of eggs of things that observe and reflect and try experiments is also explained or accounted for. To make good its claims to our favorable consideration, embryological science must undertake to account, in good time, for minds, in exactly the same sense of the word as that in which it undertakes to account for bodies and brains.

2. *The intellectual powers by the aid of which we make scientific discoveries come out of eggs.*

Honesty, and independence, and accuracy, and determination, and good sense, are essential to sound progress in scientific discovery. The investigator who is no biologist may take his own honesty, and independence, and accuracy, and determination, and good sense, for granted, as ultimate facts that do not need to be accounted for. But honest men, and accurate men, and independent men, and resolute men, and men with good judgment, all come out of eggs, and the embryologist cannot forget that they are among the natural phenomena of which he hopes to, some day, give a scientific account.

The final and decisive test of any explanation of the generation of living things out of eggs is the account which it gives of the origin and significance of our ability to observe and reflect and try experiments; for no scientific discovery is worthy of confidence, unless our intellectual means for finding out things are sound and trustworthy. Thus, the progress of embryological science must bring us around, sooner or later, by a new path, to the old question: What is science? What is it to know a thing? It may be that we shall find, from this new point of view, something in knowledge that has been neglected, or too little considered, and we may thus be helped to better notions.

3. *No embryologist can, knowingly, hold any opinion which excludes the possibility of embryological science.*

Each student of science must devote himself to some small part of the realm of nature in order to make progress. We study simple phenomena in the hope that we may pass, in time, to those that are more complex and difficult. If astronomers, and chemists, and students of physics, and embryologists, and zoologists, see fit to temporarily lay aside the natural history of mind, as a problem which does not, for the time, interest them, nor seem to concern them, or as something that is too hard for them, no one can doubt their wisdom. But if their methods and results lead them, or seem to lead them, to the conclusion that what has thus been temporarily laid on the shelf can never be taken down from the shelf, is it not clear that there has been a mistake somewhere? Any method of embryological research which leads to the conclusion that there is a 'chasm' which is 'intellectually impassable,' between the facts of embryology and the facts of consciousness, is self-condemned, because it denies the possibility of a science of embryology. Any method of embryological research which leads to the conclusion that the phenomena of consciousness are not phenomena at all, but 'epiphenomena,' and the mere empty and meaningless accompaniment, or by-product, of phenomena, is self-condemned; because the phenomena of knowledge—of embryology, and of everything else—are phenomena of consciousness.

4. *Many eminent authorities tell us an embryological account of human minds is impossible.*

It is well known that many writers, who claim to speak of the meaning of modern science with authority, have been led to believe that the facts of consciousness can never be brought back into the system of science.

Thus, for example, Tyndall tells us: "The passage from the physics of the brain to the corresponding facts of consciousness is unthinkable. Granted that a definite thought and a definite molecular action in the brain occur simultaneously, we do not possess the intellectual organ, nor apparently any rudiment of the organ, which would enable us to pass by a process of reasoning from the one phenomenon to the other. They appear together, but we do not know why. Were our minds and senses so expanded, strengthened and illuminated, as to enable us to see and feel the very molecules of the brain; were we capable of following all their motions, all their groupings, all their electrical discharges if such there be; and were we intimately acquainted with the corresponding states of thought and feeling, we should be as far as ever from the solution of the problem, How are these physical processes connected with the facts of consciousness? The chasm between the two classes of phenomena would still remain intellectually impassable."

If for *brain* we put *egg which gives rise to a brain,* this statement must mean one of two things: Either there is a chasm, which is intellectually impassable, between the facts of embryology and the facts of consciousness; or else there are two sets of embryological facts—physical and psychical—separated by the impassable chasm; and, therefore, two equally independent and distinct sciences of embryology. Tyndall cannot admit that the facts of physics may have their being in a knowing mind, for, in this case, there would not be any chasm.

Professor James, who is also a believer in the chasm, tells us there is a 'link' or bridge, but as he also tells us 'we do not know, and most authorities believe we never shall know, and never can know,' what the link is, or where the bridge is, neither link nor bridge is of much practical use to embryologists.

According to the system of scientific philosophy which finds expression in these extracts, the embryologist may hope to pass from the physics of atoms and molecules and organic matter, to physical eggs and physical men; and, if there be any psychical atoms and molecules and compounds, he may hope to pass from them to psychical eggs and psychical men; but the chasm between the sort of eggs we know and the sort of men we know is intellectually impassable.

Herbert Spencer, who is held to be the philosophical spokesman of modern science, is also a believer in the chasm; and he tells us that mind is 'something without any kinship with other things; and from the sciences which discover, by introspection, the laws of this something there *is no passage* by transitional steps to the sciences which discover the laws of these other things.'

We may pass, by a process of reasoning, from a physical candle to a physical burn, and, if this system of philosophy is to be trusted, we might, if we knew a psychical candle, pass from it to a psychical pain, but we can never pass from a physical candle to a psychical pain by any intellectual process, nor know a burn hurts in the way we know a flame burns.

5. *The chasm is not an easy thing to understand.*

Many questions are too hard for us, for we are very ignorant, and we have only feeble and incomplete command of the scientific method of finding out things; but these familiar truths are not what Tyndall and Spencer have tried to express in the passages I have quoted. These passages are no humble confession of ignorance. They are very positive assertions that something—an intellectual grand canyon—is very definitely known. We are told that we know—know with certainty—that the method which is used in physical discovery is fundamentally and utterly inadequate for dealing with the relation between bodies and minds—utterly inadequate for dealing with the relation between eggs and the thinking men who come out of eggs. The grand canyon is not merely difficult. It is utterly impassable.

6. *We are told that there is a chasm, because I cannot know the minds of other men in the way I know my own mind.*

Among the reasons which are given for belief in the chasm, the simplest is my alleged inability to know the minds of other men in the way I know my own mind. But I can never know my own body in the way I know the bodies of other men. I can have no more immediate perception that there is in my head a sphenoid bone which has arisen, during my younger stages, through the union of a presphenoid, a basi-sphenoid, two ali-sphenoids, two orbito-sphenoids, and two pterygoids, than I can have immediate perception that there is in Timbuctoo a man with a mind as much like my mind as my body is like his body. My conviction that I have passed through embryonic stages like those described in the text-books is even more remotely inferential than my conviction that my own familiar friend has a mind like mine.

The chasm between my embryonic history and that of other human beings is utterly impassable, yet its impassability is practical and not intellectual. I find no more logical difficulty in believing that I could perceive the resemblance between my brain, or my embryonic history, and those of other men, if I were in the proper place at the right time with suitable means of observation, than I find in the belief that I could thus perceive the other side of the moon.

If there is a grand canyon, it must be of a different sort from the chasm between my body and those of other men, for this is not intellectual, but practical.

7. *There is a chasm, we are told, because I know my own mind by introspection.*

It is, unquestionably, through introspection that I know my own mind and this is the reason why we are told that there is an impassable chasm between mind, on the one side, and brains and all other material things, on the other.

A moment's reflection is enough to show that it is through introspection—through comparison of my sensations, and recollections, and expectations, and other mental facts, and through reflection upon them—that I find out anything. If I neither felt nor reflected, I should not know anything. It is through reflection upon my thoughts and feelings that I make scientific discoveries about my mind, and about the minds of other men, and about everything that I know. As I have only this one way to find out anything, it is hard to imagine where the impassable chasm is, but what chiefly concerns us now is the wide diffusion of belief in its reality.

8. *The chasm is said to be between the things I may know, or might know, and something unknowable.*

The chasm cannot be between my mind and anything I know, or may know, or might know if I had the opportunity, because the things I know are in my mind, and I can never know anything except knowledge. So we are told that it is between things that are knowable and something that is not only unknown and unknowing, but unknowable.

Believers in the chasm do not all put it in the same place. Some declare that we know nothing but the molecular or electrical changes in our ganglion cells. Forgetting the existence of their own thoughts, or else dismissing them as mere 'epiphenomena,' without significance, they tell us that the chasm is between these physiological changes and the real world to which we try to refer them.

We have no immediate knowledge of our own brains, but we do know the thoughts that arise in our minds, and Tyndall tells us the chasm is not between the physiological changes in our brains and the facts of physics, but between thoughts and the physiological changes in our brains.

A third, and, on the whole, a more consistent notion, is that we know *impressions*, but can never know the thing impressing, nor the thing impressed, nor whether the thing impressing and the thing impressed are two different kinds of unknowables, or only two unknowables of the same kind. This is Spencer's opinion, as I understand it, and it is the opinion of many scientific men.

We know phenomena, or appearances, they tell us, but are altogether put off with appearances, and can never know either things or minds as they are in themselves. We know the eggs in our minds, and the hens in our minds, but as for knowing eggs as they are in themselves or hens as they are in themselves, that, we are told, is forever out of our reach on the other side of the chasm. We may know the human ovum in our minds and the thinking man in our minds, but the human ovum as it is in itself and the thinking man as he is in himself, are utterly unknowable.

When the fact that we know the hens in our minds is joined to the notion that our minds are in our heads, we reach the interesting, but startling, opinion, that the hens we know are the hens inside our heads. Efforts to escape this strange admission by the assertion that we know only the appearance, and not the reality, of hens in our heads, lead one to suspect that the intellectual chasm may not be a grand canyon after all, but only a common bog in which the wayfarer is the more completely mired by his own struggles.

He who believes he can never know anything as it really is, can never know whether what he thinks he believes or disbelieves is really what he thinks it is, rather than something quite different; so the question whether he can believe or disbelieve anything is not without interest, although we need not go into it now.

9. *The chasm is not between the things we know and the things that remain to be known.*

The embryologist is well aware that he cannot hope to find out all there is to learn about hens' eggs, or about his mind, or about anything else; but he attributes this truth to the boundless wealth of nature, and not to any inherent weakness in his methods. In this meaning of the words, he has no expectation, and no hope, that he will ever know a hen's egg as it really is; and if the chasm were only between the things he knows and the things he has not yet found out, he would frankly and humbly admit its existence and its practical impassability. But it is said to be a chasm between things knowable and things utterly and absolutely unknowable, and not a chasm between the things that are known and the things that remain to be known.

The translator of Haeckel's 'Riddles of the Universe' tells us in his preface, that the chasm has been devised by the Roman Catholic theologians for their own evil ends, but it is not kind to lay upon the backs of these heavy-laden and weary creatures a burden which Tyndall and Spencer and others have shown themselves so eager to bear with jaunty dexterity.

It is true that the slow and heavy intellect of the embryologist cannot aspire to the subtile agility which some show in dodging chasms.

"And now," says the author of 'Father Tom and the Pope,' "I have to tell you ov a really onpleasant occurrence. If it was a Prodesan that was in it, I'd say that while the Pope's back was turned, Father Tom made free wid the two lips of Miss Eliza."

"It is kissing my housekeeper before my face you are, you villain?" says he. "Go down out of this," says he to Miss Eliza; "and do you be packing off wid you," says he to Father Tom, "for it's not safe, so it isn't, to have the likes of you in a house where there's temptation in your way."

"Is it me?" says his Riv'rence; "why what would your Holiness be at, at all? Sure I wasn't doing no such thing."

"Would you have me doubt the ividence ov my sinses?" says the Pope; "would you have me doubt the testhimony ov my eyes and ears?" says he.

"Indeed I would so," says his Riv'rence, "if they pretend to have informed your Holiness of any such foolishness."

"Why," says the Pope, "I'v seen you afther kissing Eliza as plain as I see the nose on your face; I heard the smack you gave her as plain as ever I heard thundher."

"And how do you know whether you see the nose on my face or not?" says his Riv'rence, "and how do you know whether what you thought was thundher, was thundher at all? Them operations on the sinses," says he, "comprises only particular corporal motions, connected wid sartain confused perciptions called sinsations, and isn't to be depended upon at all. If we were to follow them blind guides we might jist as well turn heretics at onc't. 'Pon my secret word, your Holiness, it's neither charitable nor orthodox to set up the testimony of your eyes and ears agin the characther ov a clergyman. And now see how aisy it is to explain all them phewnomena that perplexed you. I ris and went over beside the young woman because the skillit was boiling over, to help her to save the dhrop of liquor that was in it; and as for the noise you heard, my dear man, it was neither more nor less nor myself dhrawing the cork out of this blissed bottle."

"Don't offer to thrape that upon me!" says the Pope; "here's the cork in the bottle still, as tight as a wedge."

"I beg your pardon," says his Riv'rence, "that's not the cork at all," says he, "I dhrew the cork a good two minutes ago, and it's very purtily spitted on the end of this blessed cork-schrew at this prisint moment; howandiver you can't see it because it's only its real prisence that's in it. But that appearance that you call a cork," says he, "is nothing but the outward species and external qualities of the cortical nathur. Them's nothing but the accidents of the cork that you'r looking at and handling; but, as I tould you afore, the real cork's dhrew, and is here prisent on the end of this nate little insthrument, and it was the noise I made in dhrawing it, and nothing else, that you mistook for the sound of the *pogue.*"

You know there was no conthravening what he said; and the Pope couldn't openly deny it. Howandiver he thried to pick a hole in it this way.

"Granting," says he, "that there is the differ you say betwixt the reality of the cork and these cortical accidents; and that it's quite possible, as you allidge, that the threw cork is really prisent on the end of the schrew, while the accidents keep the mouth of the bottle stopped—still," says he, "I can't onderstand, though willing to acquit you, how the dhrawing of the real cork, that's onpalpable and widout accidents, could produce the accident of that sinsible explosion I heard jist now."

"All I can say," says his Riv'rence, "is that it was a rale accident any how."

"Ay," says the Pope, "the kiss you gev Eliza, you mane."

"No," says his Riv'rence, "but the report I made."

"What makes you call the blessed quart an irrational quantity?" says the Pope.

"Because it's too much for one and too little for two," says his Riv'rence.

"Clear it of its coefficient, and we'll thry," says the Pope.

"Hand me over the exponent then," says his Riv'rence.

"What's that?" says the Pope.

"The schrew, to be sure," says his Riv'rence.

"What for?" says the Pope.

"To dhraw the cork," says his Riv'rence.

"Sure the cork's dhrew," says the Pope.

"But the sperets can't get out on account of the accidents that's stuck in the neck of the bottle," says his Riv'rence.

"Accident ought to be passable to sperit," says the Pope, "and that makes me suspect that the reality of the cork's in it afther all."

"That's a barony-masia," says his Riv'rence, "and I'm not bound to answer it. But the fact is, that it's the accidents of the sperits, too, that's in it, and the reality's passed out through the cortical species as you say; for, you may have observed, we've both been in real good sperits ever since the cork was dhrawn, and where else would the real sperits come from if they wouldn't come out of the bottle?"

"Well, then," says the Pope, "since we've got the reality, there's no use in throubling ourselves wid the accidents."

"Oh, begad," says his Riv'rence, "the accidents is very essential, too; for a man may be in the best of sperits, as far as his immaterial part goes, and yet need the accidents of good liquor to hunt the sinsible thirst out of him."

10. *The assertion that each thing has a mind of its own is irrelevant.*

One way of rescuing science from the dilemma of the chasm, which has the approval of many modern students, is to assert that every living thing, or every thing, has its own mind, and does what it does because it chooses; and that eggs and candles are, in fact, psychical eggs and psychical candles.

"Call an organism a machine if you will," says Professor Ward in his recently published Gifford Lectures, "but where is the mind that made it, and, I may add, that works it?" And he answers his question by the assertion (I., p. 294) that the mind that makes the living organism is inside it and identical with it, and that every living thing takes conscious and efficient part in its own production. The context shows that Ward believes it is as a conscious and voluntary agent, and not merely as a part of an intended system of nature, that the hen's egg is said to help to make itself into a chick. The mind that is said to be 'inside it and identical with it' is an individual and particular mind, and not the *anima mundi,* nor the mind that presides over the universe. The notion that each thing has its own mind, or is a mind, has nothing in common with the opinion that it is in one sustaining mind that we and all things have being.

The notion that now concerns us reaches its logical culmination in Major Powell's assertion that "Every body, whether it be a stellar system or an atom of hydrogen, has consciousness as judgment and choice." If a hen's egg would describe to us the way in which it makes a chick, I should be delighted to listen and learn from it; but, until it does, embryologists must struggle along in the old-fashioned way.

If each thing has its own mind, and is identical with it, there is, of course, no chasm, because we are really studying psychology, when we think we are studying physics. But this way of escape from the chasm leads us into new difficulties, which are just as impassable as the chasm, and very much more practical.

Even if we admit that the hen's egg may have, or be identical with, a mind as good as a hen's mind, the hen's body is so fearfully and wonderfully made that the wisest man, whose mind is assuredly better than a hen's mind, is at present utterly incompetent to make, or even to understand, a hen. If it is by wisdom that hens are made, it must be by a higher wisdom than a hen's, for this cannot attain to such a work.

It is not by studying the consciousness of atoms and molecules, and material things, that we have found out how to make chemical compounds, and machinery and books; and if we are ever to find out how to make living eggs, one may safely predict that it will not be through the study of the judgment and choice of the eggs of sea-urchins and frogs and hens.

Haeckel, who declares that Berkeley, of all men, believed that 'one thing only exists, and that is my own mind,' also tells us of his own belief that "the two fundamental forms of substance, ponderable matter and the ether, are not dead and only moved by extrinsic forces, but they are endowed with sensation and will (though, naturally, of the lowest grade); they experience an inclination for condensation, a dislike of strain; they strive after the one, and struggle against the other." Only they know nothing about it, for Haeckel tells us: "I conceive the elementary psychic qualities of sensation and will which may be attributed to atoms, to be unconscious." Still, while they do not know it, "every shade of inclination, from complete indifference to the fiercest passion, is exemplified in the chemical relation of the various elements towards each other, just as we find in the psychology of man, and especially in the life of the sexes. This fundamental unity of affinity in the whole of nature, from the simplest chemical process to the most complicated love-story, was recognized by the great Greek scientist, Empedocles, in the fifth century B. C., in his theory of 'the love and hatred of the elements.' It receives empirical confirmation from the interesting progress of cellular psychology, the great significance of which we have only learned to appreciate in the last thirty years. On these phenomena we base our conviction that even the *atom* is not without a rudimentary form of sensation and will."

Words are democratic, and one is, intrinsically, as good as another. What common folks call *things,* may be called *minds,* or *abracadabra,* or *x,* by any one who so chooses, provided he know what he means, and make himself understood; but if he thinks that, by calling *things minds,* he can find out anything which would not be within his reach if he called them x, he seems to me to be misled by words.

As an explanation of the generation of chicks from hens' eggs, the fantastic and pantheistic animism of the passages I have quoted is irrelevant and useless, and no student of Berkeley's works, whether his frame of mind be critical or responsive, can confuse it with the sublime conviction of this thinker that it is in one sustaining mind that we and all things have being.

12. *Belief in the chasm may be due to some error in the description of the way in which we find out things.*

There are no paradoxes nor contradictions in nature. When facts seem to contradict one another, better knowledge is continually showing that some mistake has been made. If physical science leads us, or seems to lead us, to the belief that the chasm between an egg and the thinking man who comes out of an egg is intellectually impassable, the embryologist must ask where the mistake is.

It is a hard thing to believe that, beneficial and good as science has shown itself to be, it can lead us into opinions which cannot be maintained and made consistent. Science is justified in her works, and I find it hard to believe that the paradox of the chasm can be due to the method in which discoveries are made, or that this method can involve us in contradictions, and lead to intellectual disaster.

On the other hand, it is not a hard thing to believe that there may be some error or omission in the account which successful scientific investigators give of their method. He who reflects upon the perplexities which come from the misuse of words will find it an easy thing to believe that an account of the way in which things are found out may be so imperfect that it is practically equivalent to error, leading those who try to find out things by following it into contradiction and absurdity. It may be that the philosophical spokesmen of science have been drawn into paradoxes and contradictions and doubt of the plainest things, because they have mistaken some crude and imperfect account of the way in which we find out things for the way in which we really do find out things. There may be, in knowing, something so familiar and obvious that it is commonly left out of the description of the process of knowing.

13. *We are told that we know things when we comprehend them, but knowledge may be comprehension and something more.*

The eloquent plea for science, as a guide to conduct, with which the author of a new 'Grammar of Science' begins his book, must strike a responsive chord in the mind of every student of nature.

"Apart," he says, "from the increased physical comfort, apart from the intellectual enjoyment which modern science provides for the community, there is another and more fundamental justification for the time and material spent in scientific work. From the standpoint of morality, we have to judge of each human activity by its outcome in conduct."

Something in my own mind vibrated in harmony with the author's words as I read; but, as he is soon led, by his definition of science as *the analysis and classification of facts,* to believe and to teach that our conduct is nothing but a *routine,* over which we have no real control, and for which we have no true responsibility, his premises seem to compel me to look at his book from the *standpoint of morality,* and to *judge of his intellectual activity by its outcome in conduct.*

I am puzzled, in my attempt to do this, by a moral question about the publication and sale of this book. My difficulty is this. The author's definition of science, as the analysis and classification of facts, leads him to believe, and to teach, that "the universal validity of science depends upon the similarity of the perceptive and reasoning powers of normal civilized men." A writer on the meaning of science, whose name does not appear in our author's bibliography, showed, some two thousand years ago, that the sale of this opinion for money is not honest; for if the verdict of civilized men be the criterion of science, the way to find out what nature really is must be by ballot. This old writer therefore says that our author is disingenuous when he asks us to buy and read his book in the hope of learning something which he is not able to deliver to his customers, since he himself believes we can get it only through the verdict of civilized men. If the 'Grammar of Science' is anything more than a ballot, I see no way to acquit its author of the charge of obtaining money under false pretenses.

Has not the merest savage a criterion of science which will bear him up though all men be against him? May he not appeal to nature in the same confidence that he will bring to his side all normal civilized men who do not wilfully turn away their eyes?

Herbert Spencer, who also tells us knowledge is the analysis and comprehension of facts, tells us, furthermore, that this is one of the proofs that we can never know anything as it really is, because the thing as it really is is separated, by an impassable chasm, from the appearance which is all we can know.

"For if the successive deeper interpretations of nature which constitute advancing knowledge are merely the inclusion of special truths in general truths, and of general truths in truths still more general, it obviously follows that the most general truth, not admitting of inclusion in any other, does not admit of interpretation. Of necessity, therefore, explanation must eventually bring us down to the inexplicable. The deepest truth we can get at must be unaccountable. Comprehension must become something else than comprehension, before the ultimate fact can be comprehended."

We undoubtedly comprehend a thing when we know it, but it does not follow that we know a thing when we comprehend it. The conclusion does not follow from the premises. Knowledge may be comprehension and something more, and the assertion that comprehension is knowledge, as well as all the books of synthetic philosophy that are built upon this assertion, may, perhaps, turn out to be nothing more than a new illustration of the fallacy of the undistributed middle.

14. *Knowledge must be something more than comprehension, because the known world grows with knowing.*

Here I must stop, for the present, leaving for some future occasion the attempt to find out, in the interest of embryological science, whether this account of knowing is, or is not, complete. But, before I end, I ask you to take away with you, and to consider, this familiar truth: Each scientific discovery shows us new and unsuspected wonders in nature. The unexplained things which are brought to our knowledge by each scientific explanation far outnumber the things it explains. The progress of knowledge is no mere comprehension, or gathering in. It is more like sowing seed than gathering a harvest, for the known world grows with knowing.

We are told that "when every fact, every past or present phenomenon of the universe, every phase of present or past life therein, has been examined, classified, and coordinated with the rest, then the mission of science will be complete." But if we are to judge the future by the past, classification and coordination will always continue to show us more unclassified and uncoordinated things than they classify and coordinate.

May it not be because of the inexhaustible bounty of nature, and not because comprehension is knowledge, that we can never know anything as it really is?

Each new encyclopedia is bigger than the one before, and so, no doubt, it will be to the end. If knowledge were nothing more than comprehension, or the analysis and classification of facts, the progress of science should be bringing us nearer to universal knowledge, but each new discovery puts it farther from our grasp than before, and they who know most are most convinced of its unattainableness, not because the reality of things is unknowable, but because of the innumerable multitude of things knowable.

W. K. Brooks.

Johns Hopkins University.

THIRD ANNUAL MEETING OF THE BOTANISTS OF THE CENTRAL STATES.*

FIRST SESSION, HULL BOTANICAL LABORATORY, ROOM 13, TUESDAY, 9 A.M.

The meeting was called to order by C. R. Barnes. About seventy botanists were present. J. M. Coulter was elected chairman and Albert Schneider secretary. After a few preliminary remarks the chairman called for the reading of scientific papers, which were presented as follows:

Charles F. Millspaugh: 'The Clothing of an Islet.' (No abstract furnished.) Illustrated by lantern slides.

George H. Shull: 'Variations in Several Species of *Aster*.' Counts were made of bracts, rays and disk florets in *Aster Shortii* Hook., *A. Novæ-Angliæ* L., *A. puniceus* L., and *A. prenanthoides* Mühl. The result of these counts gave but a single instance of a maximum falling on a member of the Fibonacci-series, 3, 5, 8, 13, 21, etc., the rays of *Aster Shortii* presenting a strong mode on 13; a general result giving but slight confirmation of Ludwig's results on various other Compositæ. The counting of the parts of heads collected on September 27, 30, October 4 and 8, from a single small plot of *Aster prenanthoides*, and comprising collectively all the heads produced in one season, showed, alike in bracts, rays and disk florets, a constant fall in the mean number and a corresponding shifting of the modes from the beginning to the end of the flowering season. This fact must be taken into account in the determination of place modes. There is a close correlation between the number of rays and the number of bracts, due to the fact that the rays are axillary to the inner bracts. In the four species studied the degree of imbrication of the bracts, and also the difference in form and size between the outer and inner bracts of the head are proportional to the number of bracts which bear no rays in their axils. A complete account of these studies will appear in the *American Naturalist* for February, 1902.

Edwin B. Copeland: 'The Influence of Metallic Poisons on Respiration.' Experiments with *Elodea, Callitriche,* a crucifer, fish and frog larvæ, using as stimulants copper, zinc, cadmium, silver and mercury, agree in showing that the respiration may be stimulated by a small fraction of a fatal concentration. With increasing concentration the acceleration of CO_2-evolution is greater, sometimes reaching above 25 times the normal. Evolution of CO_2 continues undiminished after plasmolysis is suspended by the poison. Copper and zinc cause the evolution of considerable CO_2 from boiled *Elodea*.

Frederick C. Newcombe: 'The Sensory Area of the Roots of Land Plants.' In the roots of land plants, sensitiveness to exter-

* Held in connection with the meeting of the American Society of Naturalists, at the University of Chicago, December 31, 1901, to January 2, 1902.

nal stimuli has been considered to be confined to the apex and to the elongating zone. The elongating zone in nearly all species is confined to the first 10 mm. of the apex. In studying the phenomena of rheotropism it was found that the region of the root posterior to the elongating zone is sensitive as well as the elongating zone itself. To determine the location of the sensory tissue, various parts of the root were shielded from the flow of the water by enclosure in glass tubes. The roots of the radish, white mustard, buckwheat, sunflower, and popcorn gave good rheotropic curves when stimulated at a distance of 10 mm. to 15 mm. from the limit of the elongating zone.

FRANCIS RAMALEY: 'Mesa Vegetation.' The plants of these long, gently sloping, flat-topped ridges are distributed in characteristic fashion, depending upon the various edaphic conditions presented by different slopes and exposures. Probably the most interesting feature to be noted is the distribution of trees and shrubs. These plants are present on the tops of the mesas at their western ends, absent farther east because of dryness, present on the north and absent on the south slopes. On the south slopes shrubs occur near the top. This portion of the slope, in most hills the driest, is here somewhat moist because the snow remains late in the spring on the flat tops, and in melting the water trickles down the sides of the hill and is absorbed near the top. There is thus more moisture near the top than farther down, and the occurrence of a fringe of shrubs and trees at the top is thus explained. Illustrated by lantern slides.

D. M. MOTTIER: 'The Behavior of the Chromosomes in the Spore Mother Cells of Higher Plants and the homology of the Pollen and Embryo-sac Mother Cells.' The author discussed the behavior of the chromosomes in the pollen mother cells of the species of *Lilium, Podophyllum peltatum* and *Tradescantia Virginica,* and in the embryo-sac of *Lilium Martagon,* with the following results: The earlier view of Farmer and Strasburger, that a double longitudinal division of the chromosomes takes place during the first mitosis, is confirmed. The second longitudinal splitting takes place in a plane at right angles to the first. This is clearly seen during metakinesis; it may occur earlier. There is, therefore, no longitudinal fission of the chromatin spirem during the second mitosis, and no reduction division in the sense of Weismann. In the reconstruction of the daughter nucleus the granddaughter chromosomes unite to form a single chromatin spirem. In *Tradescantia* especially, the granddaughter segments tend to reticulate so that an irregular spirem is the result, and the daughter nucleus approaches the structure of the resting stage. The identity of the individual chromosomes is lost in the daughter nucleus. The first two mitoses in the embryo-sac mother cell are like in character to those in the pollen mother cell, and consequently the micro- and macrospore mother cells are homologous. The type of development of the embryo-sac in which the heterotypic and homotypic mitoses result in four potential macrospores, as for example in *Helleborus,* is regarded as the more primitive, while that found in *Lilium* is considered as a derived form. No case is known in which the pollen mother cell develops directly into the pollen spore. Illustrated by lantern slides.

SECOND SESSION, 2 P.M.

Meeting called to order by the chairman. About seventy-five were present. The chairman read the following message:

Society of Plant Morphology and Physiology in session at Columbia sends greetings to Botanists of Central States at Chicago.

ERWIN F. SMITH, *President,*
WILLIAM F. GANONG, *Secretary.*

A return message was ordered sent to President Erwin F. Smith. The secretary was directed to arrange for contiguous seats for botanists at the annual dinner. Charles F. Millspaugh extended a formal invitation to all botanists to visit the Field Columbian Museum.

The reading of papers was resumed:

CONWAY MACMILLAN: 'A Marine Biological Station on the Straits of Fuca.' A series of lantern slides were shown illustrating the buildings and surroundings of the Minnesota Seaside Biological Station on the Straits of Fuca. Among the views were a number illustrating the kelp formation of the Vancouver coast and several photomicrographs of the anatomy of *Pterygophora californica* Rupr., a plant upon which particular study had been expended. The excellence of the locality as a field for station activities was pointed out and some of the plans for the coming summer were indicated.

HAROLD L. LYON: 'The Phylogeny of the Cotyledon.' Modern researches in angiospermic embryology have shown the prevalent foliar theory of cotyledons to be untenable. A careful survey of the investigations already recorded has led to the following conclusions. (*a*) The typical embryos of the Pteridophytes and Angiosperms differentiate into three primary members—the cotyledon, stem and root. (*b*) Cotyledons are not arrested leaves, but are primarily haustorial organs originating phylogenetically as the nursing-foot in the Bryophytes and persisting throughout the higher plants. (*c*) The monocotyledonous condition is the primitive one and prevails in the Bryophytes, Pteridophytes, Monocotyls and some Gymnosperms. The two (sometimes more) cotyledons of the Dicotyls are jointly the homologue of the single cotyledon of the Monocotyls. (*d*) The cotyledon always occurs at the base of the primary stem. (*e*) The hypocotyl is a structure peculiar to the Angiosperms, being differentiated between the primary stem and root. (*f*) The so-called cotyledons of the Pteridophytes, and Gymnosperms, with the exception of *Ginkgo* and the Cycads, are true foliage-leaves.

E. MEAD WILCOX: 'Valvular Torsion as a Means of Seed-dispersal in *Ricinus*.' For the purpose of securing accurate data regarding the efficiency of valvular torsion for seed-dispersal in *Ricinus*, a plant was selected, growing in an open field. The ground about this plant was divided into four quadrants designated, N.E., S.E., S.W. and N.W. The surface was frequently cultivated so that the seeds would not be blown about by winds after falling. The following table shows the distances to which seeds were thrown, measured from the base of the plant. The plant was 104 cm. in height and the inflorescence, at maturity, was 36 cm. in length:

Distance from Center (cm.).	Number of Seeds.				Totals.
	N.E.	S.E.	S.W.	N.W.	
0–49	9	29	19	11	68
50–99	8	12	16	9	45
100–149	3	7	7	14	31
150–199	5	6	4	3	18
200–249	4	6	4	3	17
250–299	1	2	1	2	6
300–349	0	2	2	0	4
Totals.	30	64	53	42	189

The greatest distance to which any seed was thrown was 325 cm. On 12 of the 19 days upon which observations were made the wind was from the south.

CYRUS A. KING: 'Fertilization and Some Accompanying Phenomena in *Araiospora pulchra*, one of the Aquatic Phycomycetes.' Araiospora has the habit of *Saprolegnia*, growing attached to twigs in water. Both genus and species were established by Thaxter in 1896. The sexual organs resemble those of the Peronosporineæ.

The oogonia when cut off contain about fifty nuclei, which move toward the periphery while the interior is still a coarse cytoplasmic mesh-work. Patches of fine meshed cytoplasm now arise at various places in the oogonium; these later fuse into one central irregular mass which never loses its mesh-like character. This central structure, which corresponds to bodies previously observed in the Peronosporineæ and *Pythium,* reaches its highest development at the time the sperm nucleus enters. Soon afterwards it begins to spread out into the peripheral ooplasm. Just before the separation of egg from periplasm, the nuclei probably all divide once, mitotically. The egg, when ripe, consists of this previously described central area, which now has a female nucleus imbedded in it, surrounded by a coarse, uniformly vacuolate peripheral portion. Enclosing the egg, though sharply marked off from it, is the periplasm which, at this time, is divided anticlinally into a single layer of cells.

No such structure as an antheridial tube was seen. The fertilizing tube is entirely of oogonial origin. The protoplasm in contact with the oogonial wall where the antheridium is appressed, and where the oogonial papilla is developed, always remains with the ooplasm. Consequently, the plasma membrane of the periplasm, as it lays down a wall between it and the ooplasm, builds the wall of the fertilizing tube. As soon as this tube is formed, the perforation is made by the papilla and a sperm nucleus and some cytoplasm are admitted. As the nuclei approach, both put out beaks which, at least in some cases, fuse. When the wall of the oospore is well developed the latter is binucleate. The important points in the paper are: (*a*) Fertilization takes place by the union of a single male and female nucleus. (*b*) An organ of attraction for the sexual nuclei arises in the early development of the oogonium and its origin, structure and fate is followed. (*c*) There is no such fertilization tube as is figured in related forms. The tube here is a conjugation tube and the opening a conjugation pore, as Harper has suggested in *Pyronema.* Illustrated by lantern slides.

FREDERICK DEFOREST HEALD: 'The Electrical Conductivity of Plant Juices.' Using the methods of physical chemistry, conductivity measurements were made for the juice expressed from the leaves, stems, roots, etc., of different plants. The following species were used: *Beta vulgaris, Solanum tuberosum, Allium cepa, Raphanus sativus, Nuphar advena, Cucumis sativus, Amarantus retroflexus* and *Portulaca oleracea.* Ash determinations were also made for the juices used and the ash redissolved in distilled water and diluted up to the original volume of the juice from which it was obtained. Specific conductivity determinations were made for the ash solutions. The following conclusions were drawn from the various determinations. (*a*) Plant juices are comparatively good conductors, the conductivity being due in large measure to the dissolved mineral substances, while the organic compounds play a minor part. (*b*) The specific conductivity of the juice obtained from the roots of plants is always considerably less than that of the juice obtained from the subaerial parts of the plant. (*c*) The specific conductivity generally increases progressively from the root upward, although in some cases the sap from the stem has a higher conductivity than that from the leaves. (*d*) In the majority of cases the specific conductivity is a rough measure of the relative amount of ash present in different parts of the plant. Illustrated by lantern slides.

H. G. TIMBERLAKE: 'Starch Formation in *Cladophora.*' The process of starch formation in *Cladophora* was described as occurring in essentially the same manner as in *Hydrodictyon* (*Annals of Botany*, Dec., 1901). In material killed in various killing fluids, sectioned with a microtome and stained with the safranin gentian-violet orange mixture, stages in the transformation of a portion of a pyrenoid into a starch grain were observed. All the starch grains arise in this manner. There is no distinction in origin between the so-called pyrenoid starch and stroma starch. In these cells starch cannot be said to be the first visible product of photosynthesis, since it is formed from a visible proteid body, the pyrenoid.

B. E. Livingston: 'Influence of the Osmotic Pressure of the Surrounding Medium upon the Growth and Production of Living Organisms.' A change in the surrounding solution may result in either a physical or a chemical change in the solution contained within the organism. By physical change is to be understood a mere change in general concentration, brought about by absorption or extraction of water. A strong solution will extract water from the organism, a weak one will allow it to be absorbed. By chemical change is meant changes caused by absorption or extraction of solute particles. Change in the water content of the protoplasm may be directly effective by causing a change in its physical properties. For instance, if water is extracted, the viscosity of the protoplasm must be increased. The same change in water content may result in a change in the chemical activity of the protoplasmic solution, since chemical activity, in general, depends upon the concentration of the solution involved. How it comes about is not known, but a review of the literature of experiments upon animals and plants shows that growth is very much retarded by an external solution which extracts water. Especially is the elongation of cells retarded. The only experiment dealing with the effect of external solutions upon reproduction is that of the author upon *Stigeoclonium*. Zoospores fail to be produced in strong solutions, but are produced in large numbers in weak ones.

H. G. Timberlake: 'Cell Division in *Riccia fluitans*.' Attention was called to the fact that the cells in the region of the growing point afford excellent material for the study of nuclear and cell division in the liverworts. A distinct cell plate, whose origin and development are the same as that of the spermatophytes, can be made out with very great certainty.

Howard S. Reed: 'The Ecology of a Glacial Lake.' The lake studied is the remnant of a lake which came into existence at the close of the second glacial period; at that time its extent was considerably greater than at present. As the water level slowly fell, aquatic and semi-aquatic species had the first opportunity to get a foothold and become established upon the land thus uncovered; as a result, the flora of the region shows a scarcity of distinctly terrestrial plants. The plants at the lake are grouped in five concentric zones occupying all the lake bottom less than twenty feet under water and the shores. The zones which have been named from their characteristic plants are as follows: (1) *Potamogeton*, (2) *Nuphar*, (3) *Carex* and *Sphagnum*, (4) *Salix* and *Populus*, (5) *Gramineæ* and *Compositæ*. The position of these zones is not permanent; they are steadily encroaching upon the lake and filling it with the soil they produce. The most important agencies in causing the advance of the zones into the water are soil, light and the morphology of the plants. As the plants make the lake more and more shallow they make it more unfit for themselves and fit for the succeeding zone. The struggle in each zone is less successful on the landward than on the lakeward side of that zone. The plants engaged in this severe struggle show a marked tendency to mass themselves in solid ranks. Illustrated by lantern slides. The paper is soon to be published in full.

THIRD SESSION, WEDNESDAY, 9 A.M.

The meeting was called to order by the chairman, and without further preliminaries the reading of papers was resumed.

C. E. ALLEN: 'Spindle Formation in the Pollen Mother-Cells of *Larix*.' At an early stage in the prophases of the first nuclear division, fibrous material is present in considerable quantity in the cytoplasm, at first staining with the triple stain like the rest of the cytoplasm. Soon the fibrous material shows a tendency to stain deeply blue. It is now seen to form an irregular reticulum throughout the cytoplasm. The fibers gradually arrange themselves radially to the nucleus; the shorter ones grow in length until a complete system of radial fibers is formed, connecting the nuclear membrane with the plasma membrane. These fibers now fold over, so that many of them come to lie parallel with the nuclear membrane, and in time to form a dense felted layer immediately outside the nucleus. From the felted layer, the multipolar spindle and finally the bipolar spindle are formed, substantially as described by Belajeff and Strasburger. The most important point brought out by the investigation is that there is a fibrous system whose history can be traced from a reticulated stage to that of the completed spindle. No centrosomes could be seen, and the possibility of their presence as cell organs or directive centers seems to be excluded. The changes in the arrangement of the fibrous system seem to be correlated with processes going on within the nucleus.

BRUCE FINK: 'Some Interesting Lichen Formations.' The author made some preliminary statements regarding our present knowledge as to factors upon which ecologic studies may be based. These factors are physical and chemical structures of substrata and the structure of lichen thalli. This introduction was followed by a discussion of some of the more common lichen formations, viz., those of smooth and rough bark, those of the boulders of our prairies, and those of calcareous pebbles or horizontally disposed calcareous rocks and calcareous earth.

H. C. COWLES: 'Ecological Problems connected with Alpine Vegetation.' Alpine problems, like all ecological problems, present two aspects, phytogeographic and morphological. Most previous field studies of alpine vegetation have failed to separate distinct phytogeographic ideas. Properly to interpret alpine conditions it is necessary to distinguish floristic distribution from ecological distribution. Again, ecological distribution has its climatic and edaphic aspects. Alpine conditions have been largely regarded as climatic, and most of the peculiarities of alpine plants, distributional as well as morphological, have been referred to atmospheric factors, such as light, temperature, moisture, air. Perhaps alpine plant forms are in the main to be regarded as the direct result of external atmospheric conditions, as Bonner has shown. The distribution of alpine plants, however, is apparently due in large degree to edaphic conditions. The timber line in general may probably be referred to atmospheric conditions, but the marked gaps and oscillations which usually occur are due in a large measure to soil relations. While xerophytes increase in the alpine parts of mountains, it is to be observed that edaphic as well as climatic factors become more xerophytic upwards. While changes occur as one traces one type of edaphic formation upwards, these changes are far less marked than are those observed in passing from one edaphic formation to another. Alpine, as well as all ecological problems, can be ultimately settled only by experimentation, and in this great field Bonnier has led the way. The field study of ecology should be regarded chiefly in the light of furnishing an intelligent basis for experiment. Illustrated by lantern slides.

R. A. Harper: 'Cell Division in Certain Blue-Green Algæ.' (No abstract furnished.)

C. R. Barnes: 'The Significance of Transpiration.' In this paper the author seeks to present a new point of view regarding transpiration, taking account of the extensive results of experimentation already attained. The purpose of transpiration is ordinarily held to be double: (*a*) to cause the influx to the leaves of a large quantity of water, that thereby a sufficient amount of mineral salts may be supplied to the leaves; (*b*) to concentrate the extremely dilute solutions thus brought to the leaves and so get rid of surplus water. These two phases of the function are held by the author to be, to some degree at least, mutually exclusive. The amount of salts absorbed is certainly dependent upon the living cortex of the rootlets and the mesophyll of the leaves. (For the purpose of the present discussion the xylem bundles may be conceived as furnishing no obstacle to water flow.) If the cortex be freely permeable, equilibrium in the distribution of any given salt will occur, assuming for a time no evaporation from the aerial parts. If then evaporation concentrates the solution the higher diffusion tension of that salt will tend to drive it to those regions where the diffusion tension is lower. This tendency, therefore, would operate against the further supply of that material to the leaves. If the cortical layers be not freely permeable, the amount absorbed is regulated wholly by protoplasmic activity and cannot be affected directly by the outside supply. The phenomena of selective absorption show that transpiration does not determine in these cases the amount of salts absorbed. The significance of transpiration is to be discovered by examining its origin and tracing its development. Under the present organization of plants exposure of wet cell walls to the atmosphere is indespensable for the solution of necessary gases, oxygen and carbon dioxid, the plant being debarred from waterproofing the cell wall so long as gas absorption is necessary. Transpiration is, therefore, considered as *unavoidable*, though in itself a constant menace to life and activity. Advantage has doubtless been taken of the xylem bundles to facilitate the movement of solutes, but there is no reason to think this essential. Transpiration also has become a protective factor with sun plants, whose temperature is thereby kept within reasonable bounds. (Since reading the paper the author has ascertained that in certain points his view of transpiration coincides with those expressed by Dr. C. E. Bessey in a paper on the function of stomata, published in Science, N. S. 7: 13–16. 1898.)

R. A. Harper: 'Binucleate Cells in Certain Hymenomycetes.' (No abstract furnished. The paper is published in full in the *Botanical Gazette* 33: 1–25. *pl. 1.* 1902.)

James B. Pollock: 'An Abnormal Development of the Prothallium of the Pollen Grain in *Picea excelsa.*' The author reported a case of a pollen grain of *Picea excelsa* in which there were four cells formed in addition to the number usually present. These four additional cells lay in one row along the external wall of the pollen grain, between the partially disintegrated prothallial cells and the external wall, against which the first prothallial cell usually lies. The four additional cells averaged about half as large as the so-called body cell or spermatogenous cell, and the row of four was almost as long as the full width of the central portion of the pollen grain. Against the thin wall which divided the four extra cells from the large cell of the pollen grain, the cells which are usually present in the pollen grain of *Picea excelsa* were arranged in their usual manner. Two partially disintegrated prothallial cells were present, also the stalk cell and spermatogenous cell. Two interpretations are possible as to the meaning of the four extra cells: (*a*) They may show merely a spontaneous variation of the pollen grain—that is, a variation whose cause is wholly hidden in the present state of our knowledge. In this case the variation would have no special significance in the interpretation of homologies. (*b*) The four extra cells may represent a reversion to an ancestral form, and could properly be called a prothallium. If this view of the case is the correct one, all the rest of this pollen grain—that is, all that is usually present in the pollen grain —may well stand for a single antheridium, and the so-called prothallial cells are the partially disintegrated cells of the antheridium stalk. The ordinary pollen grain of *Picea excelsa* is then merely an antheridium and has no cells that may be called prothallium. In the nature of the case the proof of the latter interpretation is practically impossible, since only rarely will pollen grains be found to vary in this way. If many pollen grains should be found varying in just this same way the author would be inclined to accept the latter interpretation.

The following business was transacted:

Conway MacMillan presented the following resolution to be laid on the table until the final session: "*Resolved,* That this group hereby organize under the name of the Botanists of the Central States, and resolved, further, that the chairman be empowered to appoint a committee of three, including himself, which shall have full charge of organization, membership qualification and the program for one meeting in 1902 in case it is decided to convene during that year." After discussion the resolution was tabled for later consideration.

The secretary was asked to read a communication from W. G. Farlow, accompanying copies of the 'Third Report of the Committee on Securing Better Reviews of Botanical Literature,' which were then distributed to the botanists present. On request, William Trelease explained the progress in the organization of the International Association of Botanists and especially the plans for conducting the editorial work of the *Botanisches Centralblatt,* now the official publication of the Association. He explained also the financial plans for conducting the *Centralblatt.* It was explained that it was the plan of the *Centralblatt* to publish brief abstracts of all of the more important botanical papers, irrespective of authorship and without comment; prompt cooperation of authors and subeditors would accomplish this.

The discussion of the subject, 'Cooperation among research laboratories to avoid unnecessary duplication of work,' was opened by J. M. Coulter and participated in by R. A. Harper, William Trelease and E. E. Bogue.

In the afternoon the botanists met with the American Society of Naturalists and listened to the discussion on the relation of that Society to present and proposed scientific organizations.

FOURTH SESSION, THURSDAY, 10 A.M.

The meeting called to order by the chairman. The resolution of Conway MacMillan was taken from the table and discussed. After amendment it was adopted in this form: "*Resolved,* That this group hereby organize under the name of the Botanists of the Central States; and resolved, further, that the chairman be empowered to appoint a committee of three, including himself, which shall report to the next meeting of this body a plan of organization." The chairman accordingly appointed as such committee Conway MacMillan, D. M. Mottier and himself.

William Trelease called attention to the fact that as the American Association for the Advancement of Science and the American Society of Naturalists would meet at Washington, D. C., in January, 1903, it would be desirable for the Botanists of the Central States to convene there also at the same time. It was voted that the next meeting be held in Washington, in Convocation Week, 1903. Discussion continued as to the desirability of a general union of botanical societies to constitute a really national organization, thoroughly representative, and with autonomous local sections, *e. g.*, at present Atlantic and Central sections, and as soon as possible Pacific and Gulf sections. Such a plan of organization would combine regional convenience with national authority.

At the close of the discussion the reading of papers was continued.

Clifton D. Howe: 'The Development of the Flora on a Delta Plain in Vermont.' A delta plain formed during or subsequent to the glacial period at the mouth of the Winooski river has been exposed by the gradual subsidence of Lake Champlain. The lake is now 240 feet below the general level of the delta plain. The first terrestrial flora of the plain was a sand beach flora which crossed the plain with the constantly receding beach. Then came plants which, by continually increasing the amount of humus, prepared the soil for the pitch pine (*Pinus rigida*) forest, now the controlling formation on the plain. The gentle slopes of the ravines in the now much dissected plain are controlled by a mesophytic forest of the maple-beech type. As the erosion brings the plain nearer a base level, conditions will become more and more favorable for the further extension of a mesophytic forest.

Charles F. Hottes: 'Functions of the nucleolus in plants.' (No abstract furnished.)

H. N. Whitford: 'The Physiographic Ecology of a Sand Spit Near Cold Spring Harbor, Long Island.' (Read by title.)

J. M. Westgate: 'Genetic Development of the Vegetation on an Island in the Kansas River.' In this paper the author reports the results of four years' ecological study of an island in the Kansas river. The location of the island is such that the silt deposits are heavy, and as a consequence the development of the mesophytic flora from the xerophytic flora of the sandy border is rapid. Serial photographs and notes have recorded the more salient features of the changes from year to year. The succession of formations as the mesophytic conditions obtain have been largely verified by comparative studies along the Kansas and other rivers of the Mississippi basin.

All of the botanical papers announced on the printed program were read, with the exception of the one by the chairman, which he passed by. The abstract is as follows:

John M. Coulter: 'Parthenogenesis in Seed Plants.' The term is used in its strict sense as meaning the segmentation of an unfertilized egg. Two clear cases of parthenogenesis among seed plants have been published, namely, that of *Antennaria*, by Juel, in 1898, and that of certain species of *Alchemilla*, by Murbeck, in 1901. Dr. J. B. Overton, in a thesis about to be published in the *Botanical Gazette*, announces the same phenomenon in *Thalictrum purpurascens*. In this last case the segmentation of fertilized and unfertilized eggs was compared. In the former case the segmentation occurs synchronously with that of the definitive nucleus, while the unfertilized egg delays division until the very numerous free endosperm nuclei are parietally placed. It is surrounded by a very dense mass of granular cytoplasm, and associated with its segmentation are striking changes in the zone of cytoplasm immediately in contact with the egg. Overton suggests the possibility of an enzyme being secreted by the egg, and a digestion of the cytoplasm. If this be the case, substances may well be developed in the changing cytoplasm that will bring about those physical changes in the egg that induce segmentation. Observations in other species were mentioned that indicate the possibility that parthenogenesis may be a much more common phenomenon among seed plants than has been supposed. The suggestion was also made that in any embryo sac rich in cytoplasm a parthenogenetic embryo may arise.

The chairman called attention to the model herbarium and the collection of economic plant products at the Field Columbian Museum, to which the visiting botanists would be admitted free on presentation of their registration cards. In conclusion he spoke of the interest in the meetings, as evidenced by the large number who attended all of the sessions, and of the fact that this third successful meeting of the Botanists of the Central States, a body without organization, showed that its success depended upon the spontaneous interest taken in botanical work.

ALBERT SCHNEIDER,
Secretary.

SCIENTIFIC BOOKS.

Towers and Tanks for Water Works. By J. N. HAZELHURST, Mem. Am. Soc. C. E. New York, John Wiley & Sons. 8vo. Pp. 216; 19 illustrations.

In this work the author has evidently aimed not only to discuss those features of structural design peculiar to stand-pipe and tank construction, but also to include sufficient information relating to some of the more general matters as to make the volume complete in itself. Out of the eleven chapters of the book he thus devotes two chapters to the consideration of the properties of iron and steel, two to elementary mechanics, one to the subject of foundations, and one to the painting of steel structures. The remaining five chapters deal more specifically with the design and construction of tanks, although they also contain much of a general and elementary character.

While the engineer will find such subjects as foundations, and iron and steel, much more fully treated in special works, it is certainly convenient to have in concise form such information on these subjects as will be of direct application to this particular field of design. The chapter on painting is valuable and quite in place here, owing to the great lack of information on this important subject. The subject of riveting is quite fully treated, and convenient tables are given for the use of the designer.

In the chapters treating of the principles of mechanics and their applications to the design of the structures under consideration there is much to be criticised. This portion of the book is in fact full of the grossest errors of theory, and were it not for the very absurdity of the mistakes it would be unfortunate for such a book to come into the hands of a young engineer. The treatment of tanks is also very incomplete, no consideration being given to six- or eight-post towers and practically none to the calculation and design of tank bottoms. We are warned, however, in the introduction not to expect 'elaborate calculations and deductions based upon problematical theories and conditions,' but only 'such facts as may have been verified, freed, as nearly as may be possible, from the tons of mathematical rubbish,' etc. The following are, presumably, some of the 'verified facts': On page 59 it is stated that 'the moment of forces about a point may hold each other and establish equilibrium of the body, even though the forces themselves fail to balance.' Also that 'the direction of the resultant of two forces is exerted in a line bisecting the original angle at which the forces met, and the extent of the force exerted by this resultant is the difference between that offered by the two or more original forces, or the moment of those forces.' Again, in Chapter VIII., in the analysis of the stresses in a four-post tower, scarcely any of the stresses have been correctly determined. The tower legs are straight and have an inclination of one in ten; the wind bracing is of the usual type, consisting of horizontal struts and diagonal tie rods. The method of calculating the compression in the struts is as follows: "The inclination of the column being one in ten, one-tenth of the load is transferred to the horizontal member as compression-stress, and the remaining nine-tenths is distributed at the base of the column to the foundation." The column stress being 133.9 tons, the thrust against the strut is therefore 13.39 tons; but, since the thrust from each of the two opposite columns is 13.39 tons, the strut must be designed to resist *twice that or 26.78 tons!* The stress in the strut 'in transferring the wind stress as tensile stress' is not considered, this member being designed only for the compression as above found, together with the stresses due to its own weight. In finding the wind stresses in the diagonals of the upper panel, the stress in each is taken at one-eighth of the total wind pressure on the tank, presumably because there are eight diagonals in the top story of the tower. In this way the stress is computed to be about eight tons, with an assumed wind pressure of seventy tons, whereas the correct stress is about thirty-two tons. Finally the wind stress in each column is taken as constant from top to bottom.

These and other illustrations which could be given suggest that it might have been better to admit some of the 'mathematical rubbish' so carefully excluded.

F. E. T.

Geometric Exercises in Paper Folding. By T. Sundara Row. Edited and revised by Professors W. W. Beman and D. E. Smith. Published by the Open Court Publishing Company, Chicago. 1901. Pp. x+148.

In the author's preface to this little work, dated from Madras, India, 1893, the double purpose is set forth 'not only to aid the teaching of geometry in schools and colleges but also to afford mathematical recreation to young and old, in an attractive and cheap form.' Without attempting to develop a geometry as rigidly confined to folding as the Euclidean is to compass-and-ruler work, it is shown how a large number of interesting metrical and positional relations can be illustrated without the use of instruments other than a penknife and scraps of paper, the latter for setting off equal lengths on folds. Sheets of paper adapted to the work accompany the book, and the allusions in the text to certain kindergarten 'gifts' imply the pupil's possession of an equipment of elementary geometric forms. The processes are based on the principle of congruence.

The first nine chapters are devoted to the regular polygons of Euclid's first four books, and to the nonagon. Beginning with the folding of the fundamental square, and progressing through equilateral and other triangles, the Pythagorean theorem and consequent propositions are reached, with certain puzzle squares based thereon. In Chapter X. progressions—arithmetic, geometric and harmonic—are neatly illustrated, as also the summation of certain series. This section is enlivened by the insertion of the legend regarding the duplication of the cube. It would have been an appropriate place to refer to the adaptation of the cissoid and conchoid of Chapter XIV. to the same problem.

In Chapter XI. the numerical value of π

is calculated and the regular polygons treated, in particular those of five and of seventeen sides.

Congruence, symmetry, similarity, concurrence and collinearity are taken up in the next section, and Desargues's, Pascal's, Poncelet's and other famous theorems presented for demonstration.

The remaining chapters treat of conics and other plane curves, with historical notes and references to certain applications, completing in an attractive way a valuable addition to the literature of elementary geometry—a serviceable condensation of mathematical properties, theorems, puzzles and problems. We may be permitted to doubt, however, whether the average student who has attained to that acquaintance with radicals, logarithms and positional geometry which is evidently assumed in Chapters XI.–XIV., will often stop to obtain his actual results by folding. In fact the frequent use of the word 'draw' implies the author's permission of a short-cut; but it would probably be an encouragement to the pupil actually to bring his folding into the higher problems if in connection with it the use of the compass, dividers and straight-edge were frankly sanctioned. Simply in the interest of accuracy in folding, a thin rule, preferably of nickel-plated steel, beveled, would be desirable.

Where the claim of the author is so modest and his aim in so high degree attained, the task of criticism is a light one. It is singular that the expression 'equal halves,' if in the original, should have passed two revisers unnoticed; and one could wish that pericycloids, the involute and the cartesian ovals had not been omitted, and that the relative importance of the curves treated were better indicated by the space allotted to them.

The editors have performed a genuine service in bringing this work before an American audience and in such neat and attractive form. The twenty-six exquisite half-tone illustrations with which they have replaced the line drawings of the original, are a decided enrichment of the volume. The practically equal number of footnote references to their own series, in one case duplicated, compels the question how far permission to edit carries with it advertising privileges.

F. N. WILLSON.

PRINCETON, N. J.,
February, 1902.

Pleuronectes (the Plaice). By F. J. COLE and JAMES JOHNSTONE. Liverpool Marine Biology Committee Memoirs, No. 8. London, Williams & Norgate. Dec., 1901. Pp. 260, 11 plates. Price, 7s.

In these L. M. B. C. Memoirs a single animal or plant type is described by a specialist in such a way as to serve primarily the interests of college and private students of biology and young amateurs. They are, however, far more than mere laboratory guides, being authoritative sources of information based on original work upon species which for the most part are not elsewhere adequately described.

This, the latest memoir of the series, is devoted to an important food fish, the plaice, containing descriptions with excellent figures of the skeleton, abdominal viscera, blood vascular system, nervous system and sense organs, together with appendixes on life history, habits and practical fishery matters. Its chief interest for biologists in general lies in the discussion of the asymmetry of the Heterosomata, or flat fishes, of which the plaice is probably the best known British representative.

In explaining this asymmetry the authors follow Traquair, disposing first of the mischievous assumptions that the left eye has passed either through the substance of the head or over the top of the head to reach its definitive position on the right side of the body. "The *fact* is," they remark, "that the left eye is *not on the right side at all.* Its presence there is purely illusory. What has happened is that the *whole* of the cranium *in the region of the orbit* has rotated on its longitudinal axis to the right side, until the two eyes, instead of occupying a horizontal plane, have assumed a vertical one, and the left eye is *dorsal* to the right."

The part of the work next in importance to the discussion of the asymmetry is the section devoted to the cranial nerves, which are given a thorough critical treatment. The key to the comprehension of the cranial nerves is the doctrine of nerve components as developed (chiefly by American students) during the past decade, a doctrine which apparently very few neurologists in Europe have yet really comprehended. The fifty pages of this work devoted to the peripheral nervous system will serve as an admirable and not too technical introduction to this important subject, and will doubtless hasten the day when it will filter down into the text-books. C. Judson Herrick.

SOCIETIES AND ACADEMIES.

RESEARCH CLUB OF THE UNIVERSITY OF MICHIGAN.

Since last reported this Club has held two meetings, one on December 18, 1901, the other on January 8, 1902.

At the former meeting, Dr. A. R. Cushny read a paper on 'Renal Secretion and Diuresis,' in which he first discussed the two chief theories on the subject and then attempted to apply them to the explanation of the diuresis induced by the intravenous injection of saline solutions. When a mixture of sulphate and chloride of sodium in equal parts is injected, the chloride of the urine first exceeds the sulphate in amount, while later the reverse is the case. This is most simply explained by the reabsorption of chloride in the renal tubules, which take up this salt much more readily than the sulphate. When the absorption is accelerated by partial closure of the ureter, which increases the pressure in the tubules, the chloride of the urine diminishes much more than the sulphate. The behavior of the chloride and sulphate of the urine thus confirms Ludwig's theory that the renal tubules are absorptive rather than secretory organs. In the discussion which followed, it was intimated by the reader of the paper that there were grounds to believe that the secretory cells of the renal capsule are unable to discriminate between sulphate and chloride and that the relative amounts of these in the glomerular fluid is determined by their relative proportion in the plasma of the blood.

At the conclusion of Dr. Cushny's paper, Professor Henry C. Adams spoke on 'Trusts.' Giving at first the older classification of business and commercial organizations as limited by profitable administration, the speaker devoted his time to the enquiry as to whether conditions have so changed as to make possible the profitable combination into one organization of two or more formerly economically distinct classes of business.

At the meeting of January 8, Dr. Guthe spoke on the action of the coherer with special reference to the investigations which he has published in the *Annalen der Physik*, 4, p. 762, 1901, and in the *Physical Review*, 12, p. 245, 1901.

After a short description of the single contact coherer used by him and an explanation of the so-called decohesion, he calculated how near the metallic surfaces must be brought together in order to produce coherer action. The work of Earhart on sparking distances leads to the conclusion that the insulating layer can only have a thickness of a fraction of the wave-length of sodium light, while the distance corresponding to the critical voltages of different metals, as found by him, must be of molecular dimensions. Thus the thickness of the air film, if the original high resistance is really due to such a film, can be only a very small fraction of its normal value. But it seems unnecessary to assume the presence of a layer of air between the surfaces in all cases in which coherence takes place. The decrease in resistance or actual metallic contact between the coherer particles, Dr. Guthe believed to be due mainly to the welding together of the metals at the point of contact by the heat produced when even a minute quantity of electricity passes through an extremely small area of high resistance.

Dr. Guthe was followed by Dr. S. J. Holmes, who spoke on 'The Habits of Amphipods,' detailing many interesting actions in their life history. Portions of the results obtained by Dr. Holmes have been published in the *Biological Bulletin* and in the *American Journal of Physiology*. The later observations have appeared in abstract in Science in the report of the Chicago meeting of the Morphological Society.

Frederick C. Newcombe,
Secretary.

ZOOLOGICAL CLUB, UNIVERSITY OF CHICAGO.

MEETING OF NOV. 20, 1901.

'Experiments in Grafting *Hydra*': MARY HEFFERAN.

These experiments were carried on during the year 1900 at the University of Chicago, and were based upon the similar work of Rand (1899) and Miss Peebles (1900). A comparison of the behavior of lateral grafts in the two species *Hydra fusca* and *Hydra viridis* showed a marked difference in the process of regulation. In the former, the graft moved up the stock until the head ends of stock and graft were of the same length, forming a Y-shaped figure. Then the two trunks gradually fused into one. A graft inserted very low down on the stock, *i. e.*, in the aboral 1/5, might constrict off from the foot. In *Hydra viridis* the process was quite the contrary. The graft moved down the stock instead of up, and finally separated from it at the foot instead of fusing as in *Hydra fusca*. The difference in size of the two species and the action of capillarity is suggested as an explanation of these different processes. In tangent grafts fusion took place the more readily as the area of union was increased in grafting. When poles were reversed separation took place if the area of union was so large that the polyps were unable to twist around in order that fusion could follow with poles in the same direction. It was impossible to build up *Hydra* of abnormal length by grafting several polyps together end to end. Normal form was regained usually by constriction and separation at the point of grafting, or when the compound was not much more than the ordinary length, by gradual reduction through absorption. In a few cases buds formed on such compounds soon after grafting. These buds arose entirely out of the budding region of the individual components, but within what would be the budding zone of the whole. The general results may be summed up in the words of Wetzel, '95: 'Ueberall zeigt sich ein deutliches Streben, die normal Gestalt wieder herzustellen.'

MEETING OF DEC. 4, 1901.

'Some Observations upon the Eye of *Bdellostoma Stouti*': B. M. ALLEN.

The eyes of this Pacific coast myxinoid show a very primitive structure, which is in reality the result of a complex process of degeneration. The eyeball is found imbedded in a mass of fat about three times its size. In one case, the eye was found to lie some distance beneath the outer surface of the mass of fat. Normally, however, the corneal surface lies on a level with the surface of the fat and is often flattened to form a rather extensive free surface. No eye muscles nor traces of such were discovered. No oculomotor nerves were found. No traces of them are discoverable in embryonic life (Kupffer). There is no trace of a crystalline lens. According to G. C. Price and Kupffer, a rudiment of a lens occurs at a very early stage of embryonic life, but very soon disappears. The choroid and sclerotic coats are represented by a very thin layer of unpigmented, non-vascular connective tissue without any appreciable distinction between corneal and sclerotic portions. The retina remains in the early condition of an optic cup, the outer layer (pigment layer) not being fused with the remaining layers. All specimens showed the layer in question to be widely separated from the bulk of the retina. This pigment layer is composed of a single layer of cubical cells devoid of pigment as far as I could ascertain. A layer corresponding to that of the rods and cones in higher vertebrates is clearly present. The nuclei of these structures (outer nuclear layer) are strikingly well developed and regularly arranged. Certain characteristic cells of the inner nuclear layer could be readily made out. It is impossible at present to give an accurate account of the minute histological details of this or of any other part of the retina, owing to the lack of living material. The ganglionic layer is represented by cells scattered irregularly throughout the inner reticular layer. Fibers from these last named cells can be traced in a more or less direct course to the optic nerve. The outer rim of the optic cup is in many cases differentiated in such a manner as to suggest a rudimentary iris. A structure unmistakably like an iris was found in one specimen examined. The cellular structure of this rudimentary iris is almost identical with that of the pigment layer. No indications of muscle fibers or pigment are to be seen. Certain deeply staining coagula within the optic cup give evidence of a vitreous body. Some large, clearly marked cells, probably those of the vitreous body, are found attached to the surface of the retina. Evidences of a choroid fissure are to be seen in the fact that the ventral portion of the retina is thinner than the dorsal in almost all specimens. In one case the choroid fissure was found to persist. The most striking feature, however, is the extreme variation. The optic nerve enters the eye at various angles. Variation occurs in all parts of the eye, and is especially notable in the measurements of the thickness of the retina and the dimensions of the eye as a whole.

C. M. Child,
Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON.

The 350th regular meeting was held on Saturday evening, February 22.

C. H. Townsend spoke on 'The Present Status of the Carp in American Waters,' saying that in spite of much adverse comment this fish was rapidly assuming an important place in this country and that no less than $400,000 worth was sold annually, largely in New York. It was the source of the principal fishery in the Illinois River where the bass had increased in spite of statements that carp destroyed the spawn and young of bass. The speaker believed that when the proper methods of raising and cooking carp were better appreciated it would find much favor and be an important article of food, especially among those who could not afford the prices for the most desirable species. It would be impossible to propagate the finer species of fish on a sufficient scale to keep pace with our growing population and as the carp could be readily raised it would supply the deficiency caused by the lack of other fishes.

C. P. Hartley presented a paper on 'The Pollenation of Immature Flowers,' saying that, in order to save labor, plant breeders sometimes apply pollen to flowers at the time they emasculate them. Because fair success has often resulted from this method it is now quite universally taken for granted that pollen placed on immature pistils will remain there until the pistils are receptive and then fertilize the flowers. Experiments with tobacco prove that there are flowers that are killed and caused to fall from the plants by being pollenated before their pistils are mature; and microscopic study of flowers so treated shows that the pollen germinates on the stigmas sending pollen tubes down the immature pistils into the ovaries. This growth of pollen tubes in the ovaries among ovules not sufficiently mature to admit of fertilization causes the flowers to fall. Tobacco flowers fall in about thirty-six hours after being prematurely pollenated. If pollenated when almost mature, *i. e.*, eighteen or twenty-four hours before the flowers would have opened, many will set fruit; but if pollenated two, three or even four days before maturity, the flowers invariably fall, separating smoothly from the plant at the base of the peduncles.

Datura flowers are also killed by premature pollenation, though unlike tobacco flowers they do not fall but wither away and fail to develop seeds. Doubtless other kinds of flowers will be found to be injured by premature pollenation. The growth of the pistils of cotton blossoms is checked by premature pollenation and flowers pollenated one day before maturity do not set so many nor produce as good fruits as those pollenated at maturity. Tomato blossoms fail to set fruit when pollenated six days before maturity, the failure being due to loss of vitality in the pollen. If the flowers on becoming mature be again pollenated they set fruits. Orange blossoms pollenated nine days before maturity are not injured but continue their growth and mature good fruits. This is true of seedy as well as of navel oranges and the fact that flowers of the navel oranges so treated result in fruits containing good seeds, proves that the pollen so early placed on the stigmas successfully fertilizes the flowers.

The experiments show that certain kinds of flowers are killed by being pollenated too young; other kinds fail to set fruit because the pollen placed on the young stigma loses its vitality before the pistil becomes receptive, while still other kinds will set fruits although pollenated while quite immature.

Lyster H. Dewey discussed 'The Identity of Prickly Lettuce,' stating that a plant bearing this common name, and generally considered to be *Lactuca scariola*, was introduced into the United States in the early sixties and spread with such rapidity as to become the most widely distributed exotic weed. During the summer of 1901 specimens of true *L. scariola* with runcinate leaves were received from Hamilton Co., Ohio, and this led to a reexamination of the species. It was at first thought that a common form of the American plant having leaves merely spinulose-margined, but entire or slightly wavy in outline, was *L. virosa* L. This European species however has rather large, oblong-obovate, thin leaves, not twisted to a vertical plane as are the rather thick, firm leaves of our prickly lettuce and further study proved our form to be *L. scariola integrata* Gren. et Gord. A few specimens examined exhibit a gradation between this variety and the typical form.

F. A. Lucas described 'The Armor of *Stegosaurus*,' saying that this consisted of large plates standing on edge on the back and several large spines on the tail. The first Stegosaur, *Omosaurus*, was found in England, and Professor Owen considered that the tail spine belonged on the wrist. The broad dorsal plates found with the first American specimen, belonging to the genus *Stegosaurus*, were thought to have been imbedded in the skin like the much smaller plates of the turtle *Sphargis*. It was soon recognized however that they belonged on the back and the animal was restored with a line of plates down the center of the back. Subsequent study showed clearly that there were two rows of plates, one on either side of the median line, and probably but two pairs of spines on the tail. The most recent comparisons seemed to indicate that the large upright plates were not disposed in pairs, but had an alternating arrangement, although this was unlike the armature or adornment of any other known animal.

F. A. LUCAS.

NEW YORK ACADEMY OF SCIENCES.

SECTION OF GEOLOGY.

THE regular meeting of the Section was held on January 20, with a comparatively large number of members present, and the following program was presented:

Professor R. P. Whitfield read two papers. The first was upon the Ammonite *Heteroceras simplicostatum*, in which he emended and elaborated the description of that species which he had given in the Newton and Jenny Report on the Black Hills, published in 1880, the new observations being based upon material gathered by Dr. E. O. Hovey on an expedition of the American Museum last summer. This material shows conclusively that the three genera *Hamites*, *Ancyloceras* and *Heteroceras* have no independent existence, because single individuals show the distinguishing characters of all three genera combined. This fact had been suspected by the author when at work upon the Newton material twenty-five years ago, and it has been hinted at in the writings of Hyatt and others, but these were the first specimens described which settled the question.

Professor Whitfield's second paper described a new teredo-like shell from the Laramie group of eastern Wyoming, collected by Mr. Barnum Brown, of the American Museum. This teredo, to which the author has given the name *Xylophomya laramiensis*, is more than an inch in diameter, thus ranking with the largest species of the family known.

These two papers may be found in full in the current volume of the *Bulletin of the American Museum of Natural History*.

The third paper of the evening was by Professor James Douglas and gave a description, illustrated by a topographic map and numerous lantern slides, of the famous Rio Tinto group of the copper mines of the Huelva district in Spain. These mines have been worked from time immemorial, the earliest knowledge of them dating from the Phœnicians, who occupied the country in the eleventh century, B.C. The Romans also obtained a large amount of copper from these deposits, and it is an interesting fact that the slags which they left are purer—that is, freer from copper, than those which are made there to-day. The ore is a copper-bearing pyrite, carrying some silica. The copper-bearing portions run irregularly through the iron pyrites, and the Rio Tinto Company has removed millions of tons of forty-two per cent. iron ore in getting at its copper ore. The iron ore is not profitable at the present time, although it may become so in the distant future. There are some remains of the workings of the ancients here. At Tharsis, in particular, the old shafts are very peculiarly constructed, one at least being spiral to enable the miners to carry the ore on their backs. Shelves were excavated at intervals in the walls of the shaft to enable the men to rest their loads on their weary journey to the surface.

The mines are worked now as open air diggings in circular terraces. They produce about two million tons of ore per year, and it is estimated that there are one hundred and sixty million tons in sight. Some silver-bearing galena is associated with the copper ore. The old-fashioned method of roasting the ore in heaps was kept up until 1893, but the ore is now leached by means of water. This is a long process, requiring four years for its thorough completion, but the copper is leached out so that less than one-fourth of one per cent. is left in the tailings. The great bulk of the world's supply of sulphuric acid is obtained from the Rio Tinto pyrite, which is shipped all over the world for the purpose of manufacturing the acid. Five hundred thousand tons per year are utilized in this way.

The paper was discussed by Dr. Julien and Mr. Howe, and the Section passed a hearty vote of thanks to Professor Douglas for his kindness in giving the paper.

A regular meeting of the Society was held on February 17, with the Chairman, Dr. A. A. Julien, presiding.

The first paper to be read was by Dr. O. P. Hay, on the 'Snout-fishes of Kansas.' In this paper the author presented a brief history of our knowledge of the genus *Protosphyræna*, and a statement showing what portions of the skeleton were still unknown. Those parts which are best known are the skull, especially the elongated snout, and the jaws, the shoulder and the caudal and pectoral fins. These parts have seldom been found associated, and there have been established three series of species—one on the teeth, one on the snout and the third on the fins. It is certain that, as new collections are made and studied, some of these subspecies will be reduced to synonomy. The author pointed out various errors on the part of writers in the interpretation of different elements of the skeleton, and illustrated his points by means of specimens.

Dr. A. A. Julien gave an impromptu discussion of the relation of honestones to the cutting edge of tools, in the course of which he said that the quality of a hone depended on the size and shape of its component particles, and upon the cement joining the whole together, except in the case of the novaculites from Arkansas, in which the honing quality is due to the sharp edges of minute cavities left by the solution of calcite; and in the case of the Turkey-stone, in which the honing quality is due to veinlets of quartz intersecting a rock which has been formed by silica replacing a granular limestone. A microscopic study shows that the edge of a tool is not regularly serrated, part of it being smooth and part undulatory. Viewed on edge, the sharpest tools are practically straight, while the others are more or less regularly wavy. Viewed in the cross section, a fine edge is seen to be a perfect wedge, while the duller tools show a minute shoulder.

Edmund O. Hovey,
Secretary.

SECTION OF BIOLOGY.

At a regular meeting of the Section, held on February 10, Professor W. B. Scott, of Princeton University, presented an illustrated lecture entitled, 'The Origin and Development of South American Mammals.'

The speaker began by expressing his great obligation to Dr. F. Ameghino, as also to Dr. Moreno, director, and to the curators of the La Plata Museum, for their kindness in giving him the freest use of their collections and enabling him to examine all the types of the Santa Cruz mammals.

The fauna of every continent is made up of two elements, the indigenous forms which were developed in that continent, and the immigrants from other regions. In South America this distinction is easy to draw, because of the remarkable series of Tertiary deposits which are wonderfully rich in well-preserved fossils. The Santa Cruz beds, which are almost certainly referable to the lower Miocene, contain an assemblage of mammals altogether different from those of the northern hemisphere. The fauna consists of Primates and Insectivora, very scantily represented, very numerous Rodents (though all referable to the Hystricomorphs), Marsupials, Edentates and the peculiar South American hoofed animals. The Edentates of this period represent the Gravigrada, Glyptodonts and Armadillos, but no members of the true Sloths or Anteaters have yet been found, a lack of which is probably due to climatic conditions. The Gravigrada, which are very abundant, have forerunners of all the great Pleistocene groups, but are, of course, much less specialized and are relatively small in size. The Glyptodonts, though numerous and well preserved, are not so easily to be brought into relation with the later genera of the same group.

The paper concluded with a brief examination of the remarkable Ungulates, all of which are peculiar to South America, and especial attention was called to Ameghino's discovery, yet unpublished, that in *Nesodon* there are three sets of functional incisors and canines. Incredible as such an observation may be, it seems to be well established.

HENRY E. CRAMPTON,
Secretary.

THE BOSTON SOCIETY OF NATURAL HISTORY.

AT a meeting of the Society held January 1, 1902, Dr. George H. Parker gave an account of some experiments which he had conducted on the marine Copepod, *Labidocera æstiva*, with a view to accounting for the fact that it is extremely abundant on the surface of the water along shore at night, but during the hours of daylight is found only down in the deeper waters. After giving a short account of the external structure and method of locomotion, the speaker described a series of experiments with these copepods in aquaria, from which it appeared that the females are negatively geotactic, their tendency being to swim against rather than with the force of gravity. They were also found to be attracted by a light of small intensity, but repelled by a brilliant illumination. The reactions to light seem to be stronger than those to gravity. The diurnal migration on the part of the females is thus to be explained as being due to their endeavor to seek a region of such depth below the surface of the water as shall have the requisite intensity of light. The males of this species seemed to show no very definite response to light or gravity, though their reactions indicated that they were to a slight degree negatively phototactic, and positively geotactic. By experiments with females enclosed in small glass tubes, which were covered with filter paper and plugged at the ends with cotton, it seemed evident that the females give out some sort of scent which becomes disseminated throughout the immediately surrounding water, and is strongly attractive to the males. The males, then, perform the same diurnal migration as the females, because they are attracted by the scent of the latter, and so follow in their wake. Mr. C. J. Maynard then gave an account of the habits and structure of the Anhinga and the Courlan, two Florida birds. Among the specimens shown was a preparation of the peculiar convolution of the trachea in the adult male of the latter species, a striking secondary sexual character.

At the meeting of January 15, 1902, Mr. William L. W. Field gave an account of a 'Glacial Lake Problem in Southern Vermont.' The region studied covers a portion of the basins of the Black and the Williams rivers, tributaries of the Connecticut. At a certain locality the courses of these two rivers approximate rather closely, and at this region there are two passes connecting the respective river basins, the one very narrow, with steep sides, locally known as Proctorsville Gulf, the other, farther down the valley, much broader and apparently widened to a considerable extent by ice action. From a study of the sediments and the topographic features, it seemed probable that during the recession of the glacial ice-sheet a lake had been formed, which, as the ice melted out, had discharged first through the upper pass, and later through the lower one. A number of lantern slides were shown in illustration of the topographic features of the area under discussion.

Glover M. Allen,
Secretary.

DISCUSSION AND CORRESPONDENCE.

THE ENDOWMENT OF RESEARCH.

To the Editor of Science: I have been much impressed by the communication of Mr. H. H. Clayton in your recent issue, in relation to the subject of grants for scientific research, for the reason that his views coincide so closely with mine, based on both theoretical considerations and practical experience.

On two occasions I have been the recipient of such grants, and I confess that on each occasion I labored under a feeling of constant uneasiness for fear that I might not be able to accomplish what others might consider adequate returns for the amount of the grant. This feeling may have no reason for existence and perhaps it does injustice to those who have such funds in charge, but that it exists and that it has a distinct influence upon many applicants can not be questioned. It may perhaps be objected that such persons should not, or at least that they need not, seek to avail themselves of such opportunities, but this, it seems to me, would merely result in debarring many conscientous workers, while at the same time encouraging others not so sensitive.

In regard to the effect of prohibiting the payment of personal expenses out of research funds I may not be considered a competent witness, for the reason that in the two instances mentioned I was not restricted as to the manner in which the grants should be expended and it was never necessary for me to try to draw a hard and fast line between what might be considered purely personal expenses and those which were incurred solely in connection with the actual research work. Had such restrictions been imposed, however, I believe that I should have hesitated to accept the first grant and know that I should have declined the second, on account of my inability to satisfy myself that I could draw a line so that items on either side could not be questioned or criticized.

In common, as I have reason to believe, with nearly every active scientific worker, I have always had sufficient work under way, or definitely planned, to occupy all my time for months and sometimes for years ahead, and tardiness in completing investigations has more often been due to the element of personal expenses than to any other cause. Such a condition is particularly in evidence where investigations involve the necessity of traveling. Good results can hardly be expected if the investigator is constantly harassed by having to consider whether each item of expense may be conscientiously charged to his research fund or not. The success or failure of an investigation in the field may often depend entirely upon the length of time which can be given to it, or, what is the same thing, to the sum available merely for living expenses.

In regard to laboratory work I can not speak from experience, but I do not see why any different principle should prevail in that connection than in any other. The proper basis for a grant, it seems to me, should be absolute confidence in the recipient, giving him to understand that the amount of the grant was his, to apply in any way which he might think would best accomplish, or assist in accomplishing, the object of his investigations.

Arthur Hollick.

SCIENTIFIC NOMENCLATURE.

A prime characteristic of the scientific mind is the ability to enter into details and to make distinctions, as well as to see the relation between the elements of knowledge. In order that some conception of these distinctions may be communicated to another mind, names must be given to a perpetually increasing list of objects and qualities, with divisions and subdivisions. In natural science, to try to stretch an existing vocabulary and make it cover new conceptions by using old names with new meanings, is to invite obscurity and misunderstanding.

The unscientific mind may not always appreciate the requirements of classification as an important aid to scientific development. To one who is not a geologist nor an agriculturist, a clod of earth may be sufficiently described by a word of three letters. It is mud, and there is nothing more to be said about it. But the man who has learned to use his eyes (and one need not have a college education to do that) perceives that there may be fifty different kinds of mud; and the scientist who wishes to investigate the subject of soils and the rocks from which they are made, recognizes the necessity of an exact and elaborate nomenclature.

This need comes, in the first place, from the use of terms *as mere tools for facilitating analysis*, and thus favoring the development of a research. In this sense, that is to say, as provisory terms, invented by the investigator for the purpose of mapping out and arranging his work in an orderly way, it is desirable that the vocabulary shall be so full that it may seldom or never be necessary to use names with a double significance. Not all of these names will be retained eventually, but the looker-on must learn to tolerate them, at least during the incipient stage of path-finding investigation.

In the next place, entirely new branches of knowledge require the invention of whole classes of terms, constituting virtually a new language. To dissent from this position, and to require that the new thoughts shall be clothed in familiar forms, is as unreasonable as to require that the proposition of the maximum economy of material in the construction of the bee's cell shall be demonstrated without the use of the differential calculus, or that all psychological propositions shall be stated in terms of one sense, that of sight.

The final forms which shall be given to words expressing necessary and permanently useful distinctions of meaning are a matter which may well concern all scientific workers, whatever their specialties, as well as the general public. It is of course desirable that a new word shall be short, if this desideratum is compatible with intelligibility. Unfortunately, most of the short-cuts which are proposed from time to time, such as sweeping reforms of an extensive and tremendously cumbersome chemical nomenclature by substituting words of one syllable, break down under a weight of meaningless memorizing which is absolutely prohibitive. Common names of plants and animals become overloaded with so many meanings in different localities as to be equally useless. The prevalent custom of inventing names by joining Greek or Latin words of cognate import, giving to the new term a special and new significance, has the advantage that the word-coinage is, to a degree, self-explanatory, at least to one who has learned a modicum of Greek and Latin words. There is no royal road to knowledge. Scientific descriptions remain unintelligible to the lazy man who hates to use the dictionary. They are free property to all who are willing to take this trouble.

FRANK W. VERY.

ENGINEERING NOTES.

INDUSTRIAL ECONOMICS.

AN interesting and probably important fact, and one which may ultimately have a serious influence upon the relative standing, industrially, of the United States and Great Britain, is reported by English papers. It is the signature of an agreement between the employers and workmen in the machine shops of Great Britain which, on the whole, would seem entirely reasonable, while in the United States the unions have refused to enter into a similarly reasonable arrangement. The initiation of the displacement of British manufacturers from their own markets and from the markets of the world was largely due to the restriction of production and the deprivation of free workmen of the privilege of working at their trades, while, in our own country, restriction of production was almost unknown and freedom of the individual was at least not absolutely destroyed. It now looks possible that the conditions may be reversed.

The British agreement provides that the unions shall not interfere with business management, nor the employers with the proper functions of the unions; the men may join the unions or remain free as they may choose and the employer may employ union or non-union men; piecework is approved and restriction of output specifically disapproved. No limitation of the number of apprentices is permitted. In case of disagreement regarding any question arising between the two parties, reference and arbitration will be prescribed and work shall not stop when such question arises or during the session of the committees of arbitration.

Had these principles been in force in recent years, it is hardly to be believed that the long and costly strike which finally broke up the former tyranny would have occurred or that Great Britain would have experienced, as now, competition of serious character within her own boundaries.

On the other hand, should the false principles formerly so destructive of British industries find extensive lodgment in the United States, as now seems possible, it can hardly be doubted that the experience of the older country will be repeated in our own. Restriction of production has been a cardinal principle with many associations though, fortunately, not with the most intelligent and well-managed, nor so generally and effectively as to as yet seriously impair the industrial prosperity of the nation. The future of our industrial organization may be found to depend, nevertheless, upon the intelligence, the courage and the firmness of the leaders in the unions and upon their success in the maintenance of right principles in fixing the relations of employer and employee. Freedom in bargaining, independence of the individual who chooses to be free and independent, freedom of the ambitious and industrious and skilful, within or without the union, to secure the full value of his best efforts, and entire freedom to secure maximum output in both quantity and quality are now assured the British workman, for the first time in at least two generations, and, in default of similar freedom and independence and of similar economic practice in the United States, the tables may once more be turned. The spirit of fairness and the intelligence and knowledge of economical principles displayed by the leaders of the unions of most intelligent and highly skilled workmen in the United States and the rapidity with which a good example makes its impression in this country give assurance that the progress of the country industrially is not likely to be suddenly or soon checked. When an enormous organization like, for example, the Railway Trainmen's Association, makes fair play and industrial peace a cardinal doctrine, and when their associates of the Locomotive Engineer's unions have a record of not more than two or three serious strikes in a generation, it may be fairly anticipated that reason and justice will ultimately prevail generally.

MR. MARCONI'S ACHIEVEMENT.

The month of February and particularly the 23d and 25th of February, 1902, will undoubtedly become historically recorded as the beginning of what may be known as the Marconian era. It was on the first of these dates that a message was transmitted more than a thousand miles, between a station on the coast of Cornwall and a ship at sea in the midst of the Atlantic, and it was at the second of these dates that distinct signals were repeatedly transmitted over a distance exceeding two thousand miles under similar circumstances and permanently recorded on the tape of the receiving instrument. The practicability of the system of wireless telegraphy operated by Mr. Marconi was thus confirmed as effectively for these enormous distances as it had been, long before, by constant use over shorter ranges, for months together, on the coasts of England, France and the United States.

The Marconi station at Poldhu, Cornwall, has been in use a long time, not simply for the usual work of exchanging messages with ships at sea in that neighborhood, but also in the investigation of the problem of transmission over the ocean, from shore to shore. Weeks before it had been found possible to reach the coast of Newfoundland with distinct signals and Mr. Marconi, returning to England, refitted his apparatus for a test which should be crucial. He left Southampton on the U. S. M. S. *Philadelphia* February 22d and, with a prearranged system, communicated with his operator at Poldhu, regularly, from a point 250 miles west of the Lizard until reaching mid-ocean, over a thousand miles away, the operator reported "Fine here. Thanks for message!" Thence, to a point 1,551 miles away, messages continued to be intelligible, the last, 'All in order,' indicating that the cessation was due to lack of power in the sending apparatus, not to any defect of construction or adjustment. Single signals nevertheless continued to be recognizable, and were automatically recorded on the tape, until the two operators were separated by 2,099 statute miles. The records of all these messages and signals were properly certified to by the operators and by the officers of the ship, in order that the scepticism manifested at the first announcement of Mr. Marconi's work in Newfoundland might not be given a shadow of an excuse for expression in this instance. During this experiment the messages and signals transmitted to the *Philadelphia* passed over the *Umbria*, following in her wake all the way across the Atlantic, or within easy communicating distance, without being recognized or even detected.

Mr. Marconi is now confident that he has demonstrated that the distance over which his method will prove available is only limited by the power of the sending apparatus. He is preparing to establish at Poldhu ten times as much transmitting power as was available on this occasion. It may probably be admitted as demonstrated that we may anticipate the successful transmission of messages between a ship at sea and the shore, on either hand, from the moment of her setting out on her voyage until her passengers are landed at her destination on the other side of the ocean. Then the previously unavoidable period of anxiety attending the disappearance of ship and crew and passengers, for days together, will be at an end forever. New, or temporary, or moving stations may be established at sea or on land, and a campaign may be conducted, in time of war, with perfect communication between forces and commanders however relatively situated and, with suitable codes, without enlightening the enemy, even if the fact of communication be detected by him at all.

R. H. THURSTON.

ANNUAL REPORT OF THE CONCILIUM BIBLIOGRAPHICUM.

THE general statement for 1901 has just been issued from Zürich and shows that Dr. Field's determination to carry this project through is at last beginning to meet with reward. The total number of cards published in 1896 was 3,345, and in 1901, 21,946. The total number of cards issued up to December 31, 1901, is 9,671,500. The total expenditure up to the same date is 119,015 francs, or in round numbers $23,803. The receipts up to the same date have been 92,484 francs, thus leaving outstanding amounts of upwards of 21,000 francs or something over $4,000, probably due to losses in the two first years of inauguration, which will soon be covered by the present increasing sales.

The financial standing of the present year shows a great advance over all that have preceded; the increase of subscribers has been so great that whole sets have gone out of print. The prices charged for subscriptions correspond, however, so closely to the actual cost that the increased sales have occasioned increased expenditures to nearly the same amount. It is the generosity of the Swiss Government to which in the main the Concilium owes the present improved state of its finances. While this shows the permanence of the work, it is very desirable that other countries should give similar aid and thus remove the last of the difficulties under which Dr. Field and his staff are struggling.

In consequence of the failure of an expected subsidy, the physiological part of the work has been temporarily suspended, but it is hoped that this impediment will soon be removed.

A recent report of the Swiss Society of Naturalists estimates the saving of time afforded by the great catalogue in the specific case of an investigation on the trout; the report says that in looking up the recent literature of this subject by means of the Concilium catalogues the saving of time was estimated at one half a day, but in regard to other cases the saving is much greater. If any zoologist familiar with the best bibliographical resources considers how he should go to work to ascertain what has been published in the past five years in regard to some comparatively minute question, such as the fauna of Sumatra, a minute's reflection will suffice to show that it would be a task of many weeks to obtain a complete answer to such a question. Yet a subscriber to the faunistic part of the bibliography of the Concilium would require only a few seconds to find the 85 publications dealing with the subject. Some of the latter, indeed, bear titles which would appear to preclude any reference to Sumatra and thus be likely to be missed by the student altogether. These 85 references would have cost the subscriber sixteen cents. Surely no argument is necessary to prove the value of the work nor the extreme cheapness of the service.

The general statement contains a key by which subscribers can verify their subscriptions and rest assured that they have received all that has been last published on any subject. The zoological and anatomical subjects include 760, 8,371 and 2,007 cards respectively during 1901. There are 263 cards on microscopic technique and 155 on general biology.

American subscribers will find it convenient to remit to Mr. Edwin S. Field, 427 Broadway, New York City, and also copies of the general statement for 1901 can be secured.

SCIENTIFIC NOTES AND NEWS.

Lord Kelvin is expected to arrive in New York on April 19. A reception will be given in his honor on the evening of April 21 by Columbia University, the American Institute of Electrical Engineers, the New York Academy of Sciences and other scientific societies.

Lord Lister and Professor Virchow are among those who have been elected honorary members of the Ghent Medical Society.

Dr. N. L. Britton, director of the New York Botanical Garden, expects to visit Cuba at the end of the present month, with a view to securing collections for the Garden. Dr. D. T. MacDougal, assistant director, is at present in Arizona and New Mexico, making collections, particularly of giant cacti.

Mr. William T. Palmer, of the U. S. National Museum, has been engaged in investigations of the natural history of Cuba.

Dr. Brandes has been appointed scientific director of the Zoological Gardens in Halle and has resigned his position as assistant in the zoological laboratory of the University.

Professor Hermann Kobold, astronomer in the Observatory at Strassburg, has removed to the Observatory at Kiel.

Professor H. Becquerel lectured in French before the Royal Institution on March 7. His subect was 'Radio-active Bodies.'

Dr. Simon Flexner, professor of pathology in the University of Pennsylvania, gave a lecture on March 18 before the Yale Medical Alumni Association on the subject 'Bubonic Plague.'

An address on 'Immunity' was delivered on March 7 before the students of Jefferson Medical College, Philadelphia, by Dr. W. H. Welch, of the Johns Hopkins University.

At the meeting of the Michigan Academy of Science to be held at the University of Michigan on March 27, 28 and 29, a public lecture will be given by Major Walter Reed, of the Army Medical Museum, at Washington, chairman of the U. S. Yellow Fever Commission. His subject will be 'Yellow Fever.'

C. N. Brown, professor of civil engineering in the Ohio State University and dean of the College of Engineering, died on March 6 from nervous prostration. He was forty-four years of age and had been connected with the Ohio State University as instructor and head of the department of civil engineering for the past twenty years.

Dr. Emil Selenka, honorary professor of zoology and comparative anatomy at the University of Munich, died on January 21.

The House Committee on Coinage has directed a favorable report to be made on the bill providing for the adoption by the United States of the metric system. It provides that after January 1, 1904, all the departments of the government, in the transaction of all business requiring the use of weight and measurement, except in completing the survey of public lands, shall employ and use only the weights and measures of the metric system; and after January 1, 1907, the weights and measures of the metric system shall be the legal standard weights and measures of and in the United States.

THE Entomological Society of Western Pennsylvania was organized at the Carnegie Museum in Pittsburgh on the evening of March 8. Dr. W. J. Holland was elected president, Mr. F. A. Merrick, of New Brighton, secretary, and Dr. D. A. Atkinson, of Pittsburgh, Treasurer. Twenty-three persons participated in the organization. A committee with Herbert H. Smith as chairman was appointed to prepare a constitution and by-laws. The next meeting will be held on April 5.

THE thirteenth session of the International Congress of Americanists will be held in the halls of the American Museum of Natural History, New York City, October 20–25, 1902. The object of the congress is to bring together students of the archeology, ethnology, and early history of the two Americas, and by the reading of papers and by discussions to advance knowledge of these subjects. Communications may be oral or written, and in French, German, Spanish, Italian or English. All debates are expected to be brief, and no paper must exceed thirty minutes in delivery. The papers presented to the congress will, on the approval of the bureau, be printed in the volume of proceedings. Members of the congress are expected to send, in advance of the meeting, the titles and, if possible, abstracts of their papers, to the general secretary. The subjects discussed by the congress relate to: (1) The native races of America, their origin, distribution, history, physical characteristics, languages, inventions, customs and religions, and (2) The history of the early contact between America and the Old World. All persons interested in the study of the archeology, ethnology and early history of the two Americas may become members of the congress by signifying their desire to Mr. Marshall H. Saville, general secretary of the commission of organization, American Museum of Natural History, New York, and remitting either direct to the Treasurer (Mr. Harlan I. Smith, American Museum of Natural History), or through the general secretary, the sum of three dollars. The receipt of the treasurer for this amount will entitle the holder to a card of membership and to all official publications emanating from the thirteenth session of the congress. Mr. Morris K. Jesup is president and the Duke of Loubat vice-president of the commission of organization.

THE American Social Science Association will hold its general meeting in Washington, beginning Monday, April 21, and closing Friday, April 25. Dr. Oscar S. Straus, president of the association, will deliver his address on the first day. The program for April 22 will be devoted to the department of social economy, of which Mr. John Graham Brooks is chairman. The department of jurisprudence, of which Dr. Francis Wayland is chairman, will hold its sessions on the 23d. General George M. Sternberg, chairman of the department of health, will preside at the session on Thursday, April 24. Dr. W. C. Woodward and Professor George M. Kober will make addresses at the morning session and General Sternberg and Mr. Charles F. Weller will be the speakers at the evening session.

THE convocation of the University of the State of New York is to be held at Albany on June 30 and July 1. On Monday evening, June 30, Dr. Nicholas Murray Butler, president of Columbia University, will deliver the principal address, on 'Fundamental Principles of Education in the United States'; on Tuesday President Schurman of Cornell University will open a discussion on 'The Elective System and its Limitations.'

THE Jefferson Memorial and Interstate Good Roads Convention will be held at Charlottesville, Virginia, on April 2, 3 and 4 under the auspices of the Office of Public Road Inquiries of the Department of Agriculture, the National Good Roads Association and the Jefferson Memorial Road Association. The

Southern Railway good roads special train, carrying twenty-two engineers and road experts and equipped with fifteen car loads of the latest improved road-making machinery, will arrive at Charlottesville on March 24, and begin the construction of the Jefferson Memorial Road which will connect the home and tomb of Thomas Jefferson with the University of Virginia, which he founded.

The managers of the New York Botanical Garden have authorized the purchase in Berlin for $1,600 a collection of botanical works all dated prior to 1800.

The *Osprey* states that an interesting and valuable collection of northeast African birds has been recently received by the U. S. National Museum from Dr. A. Donaldson-Smith of Philadelphia, the well-known African explorer.

An anonymous gift of $20,000, for the benefit of the Harvard College Observatory, has been received from a friend of the director, Professor Edward C. Pickering, who in announcing the gift says: A very urgent need of the observatory will be relieved at once by this gift. The building provided, nine years ago, for the astronomical photographs, has become wholly inadequate to contain them, owing to their continual and rapid growth. It is proposed to expend about one half of this fund in extending the present building, by the erection of a wing to the east, which will provide for the adequate storing of this collection with its probable increase for many years. These photographs furnish a history of the entire stellar universe for the last twelve years, which is not duplicated elsewhere. Whenever a new object is discovered in any part of the sky, we are therefore able to study its past history during this period. Evidently, provision should be made for extensive use of this collection by large numbers of astronomers. A much larger building, staff and endowment, than our present means permit, would be required for this purpose. Accordingly, the new wing will be so constructed that when these plans are carried out, it can be used for holding the valuable collection of astronomical books (one of the most complete in the world) belonging to the observatory. These books are now contained in a wooden building fifty years old, and are in danger of destruction by fire at any time. The remainder of the fund will be expended from time to time as urgent needs occur. It is proposed to employ a portion of it at once in studying new objects of interest on the photographs, since without it we have hitherto only been able to examine those of special importance. The value of a fund which will provide for such emergencies must be obvious. The larger plans described above, I hope, indicate the healthy and insatiable appetite of an institution which is always attempting to reach out into untrodden fields, and in which each accession suggests opportunities of still further extending its work into the unknown.

The thirteenth session of the Biological Laboratory of the Brooklyn Institute of Arts and Sciences, located at Cold Spring Harbor, Long Island, will be held for six weeks beginning July 2, 1902. The following courses of instruction are announced: High School zoology, Drs. C. B. Davenport and S. R. Williams; comparative anatomy, Professor H. S. Pratt, of Haverford College; invertebrate embryology, Professor C. P. Sigerfoos, University of Minnesota; animal bionomics and variation, Dr. Davenport; investigation in zoology, by various instructors; cryptogamic botany, Professor D. S. Johnson, Johns Hopkins University; plant ecology, Mr. S. M. Coulter, Washington University, assisted by Louise B. Dunn, of Columbia University; seminar in the same; bacteriology, Professor F. N. Davis, Bucknell University; investigation in botany; microscopic methods, Mrs. Davenport; nature study, Mr. Roy S. Richardson, High School, Brooklyn, N. Y. Biological discussions, lectures and excursions are arranged for. The tuition is $25 for the use of the laboratory. Board and room cost $6 per week. The director of the laboratory, who may be addressed for further details, is Professor C. B. Davenport, the University of Chicago.

The Ohio State University announces for the 1902 session of its Lake Laboratory at Sandusky, on Lake Erie, courses in zoology, botany, entomology, ornithology, ichthyology, and vertebrate and invertebrate morphology. The courses of lectures and laboratory instruction open on July 7 and continue for six weeks, but the opportunities of the laboratory are open to investigators from June 15 to September 15. Investigators qualified to carry on independent research work are given the facilities of the laboratory free of expense, but persons desiring this opportunity should apply to the director as early as convenient with statement of the time during which table room is desired. A detailed circular may be had on application to the director, Professor Herbert Osborn, Columbus, Ohio.

A TELEGRAM has been received at the Harvard College Observatory from Professor Hussey at the Lick Observatory stating that from a recent Crossley photograph Professor Perrine finds no evidence of polarization in condensations *A* and *D* of the nebula surrounding Nova Persei.

Nature states that the Russian Geographical Society has awarded this year its Constantine medal to the geologist, K. I. Bogdanovitch, who has spent several years in the exploration of Central Asia and has contributed one large volume to the beautiful series of quarto volumes edited by the Society and devoted to this part of Asia. The Semenoff medal has been awarded to Professor Eduard Suess for his new classical work, 'Das Antlitz der Erde,' and the Prjevalsky medal to the zoologist, Professor Zarudnyi, the author of several most valuable works on the birds and also the geography of the Transcaspian region, and the author of a work, 'Journey to East Persia,' just published by the Society. The great gold medal of the section of statistics has been awarded to N. V. Slyunin, for his researches into the economical conditions of the inhabitants of the Okhotsk and Kamchatka coasts. Three small gold medals have been awarded to Messrs. N. P. Petrovsky, D. K. Zelenin and M. N. Kositch for ethnographical works published in the excellent ethnographical periodical of the Society, *Zhivaya Starina (Living Antiquities)*. Professor Gordyaghin, of Kazan, has been awarded the Prjevalsky silver medal for his botanical work in East Russia, and the Semenoff silver medal has been awarded to A. K. Bulatovich for his journey to Lake Rudolph. A number of small silver medals have also been awarded, chiefly for meteorological work in connection with the Society's meteorological committee, or for expeditions.

Nature learns from the *Ceylon Observer* that Mr. Alexander Agassiz and his party have returned to Colombo, from their exploration of the Maldives. About three hundred photographs were taken, principally of coral-reef subjects. The principal work done was the sounding of the channels between the lagoons and the development of the plateau on which the atolls of the Maldives have been formed. The principal atolls are separated by comparatively shallow water in the central part of the group, while towards the south, between Hadumati and Suvadiva and Addu, the depths are very much greater—nearly a thousand fathoms. A line was run to the westward of Ari Atoll into fifteen hundred fathoms, and one to the southward of South Male into twelve hundred fathoms, showing that the plateau of the Maldives is much steeper on the west than on the east face. Soundings were also taken between the northern Maldives and Colombo, and they show that the Maldives are separated from the Indian continental slope by a deep bank of the ocean of more than fifteen hundred fathoms in depth. The atolls of the Maldives are said to exhibit the most simple and primitive conditions for the formation of atolls which are found anywhere except in some parts of the Yucatan plateau in the West Indies. Atolls can be found in all stages of growth, from a mere bank rising to a few feet above the plateau to banks within five or six fathoms from the surface or to banks which have just reached the surface and on which sandbanks or islets are beginning to form. Mr. Agassiz says that one reason for the success of his expedition is that the charts published more than seventy years ago are as accurate to-day as they were then. The only changes noticed were changes such as the washing away of banks or the formation of banks since the charts were published; but these are changes without any special importance.

UNIVERSITY AND EDUCATIONAL NEWS.

MRS. COLLIS P. HUNTINGTON has given $250,000 to the Harvard Medical School to erect a laboratory of pathology and bacteriology in memory of the late Mr. Huntington. The sum of $821,225 has now been collected which makes available Mr. John D. Rockefeller's gift of $1,000,000. The donors to this fund whose gifts are $5,000 or over are as follows:

Miss Mary S. Ames	$5,000.00
Oliver Ames	5,000.00
C. W. Amory	10,000.00
Anonymous	10,000.00
Robert Bacon	25,000.00
Francis Bartlett	10,000.00
Mrs. S. Parkman Blake	10,000.00
John L. Bremer	10,000.00
Mrs. John L. Bremer	5,000.00
Miss Sarah Bremer	5,000.00
Walter C. Cabot	5,000.00
W. Murray Crane	5,000.00
George F. Fabyan	25,000.00
Mrs. William H. Forbes	5,000.00
Augustus Hemenway	15,000.00
Francis L. Higginson	60,000.00
George Higginson	10,000.00
Henry L. Higginson	10,000.00
James J. Higginson	10,000.00
H. H. Hunnewell	12,500.00
Mrs. Collis P. Huntington	250,000.00
Eben D. Jordan	5,000.00
David P. Kimball	5,000.00
Elliott C. Lee	25,000.00
Joseph Lee	5,000.00
Arthur T. Lyman	5,000.00
W. L. Richardson	25,000.00
Mr. and Mrs. Frederick C. Shattuck	50,000.00
David Sears	25,000.00
Francis Skinner	5,000.00
John T. Spaulding	10,000.00
W. S. Spaulding	10,000.00
James Stillman	100,000.00
Nathaniel Thayer	25,000.00

WE noted last week the gift of £25,000 of Mr. William Johnston to University College, Liverpool. We learn from *The British Medical Journal* that the £25,000 is divided as follows: £10,000 is allocated to found a chair of chemical biology, £6,000 at 5 per cent. interest to permanently endow three research fellowships of £100 a year each. Of these fellowships one is to be held by a medical graduate of a colonial university, a second by a graduate of medicine of the United States, and a third by a research student in gynæcology. The remaining £9,000 is to be spent in building a laboratory adjoining the Thompson-Yates laboratories, to accommodate the Tropical School, the professor of chemical biology, experimental medicine, comparative pathology, and serum research departments.

JOHN D. ROCKEFELLER has offered to give $25,000 to the endowment fund of William Jewell College, Liberty, Mo., provided $75,000 additional is raised by January 1, 1903.

THE corner stone of the science and administration building of Colorado College has been laid. The building, to cost $225,000, will be three stories high, 287 feet long and 95 feet wide, the material being sandstone. A natural history museum will be installed in the building, with laboratories for scientific instruction.

THE Laboratory of Chemistry and Metallurgy, at Lafayette College, the gift of Mr. James Gayley of the class of '76, will be dedicated on April 5. The program for the dedicatory exercises includes addresses by President Ira Remsen, of Johns Hopkins University; President Thos. M. Drown, of Lehigh University, and Professor Henry M. Howe, of Columbia University.

THE Science Hall, University of Montana, was practically destroyed by fire on March 14. The building was erected three years ago at a cost of $100,000. The loss is covered by insurance.

AT a conference of representatives of the governors of King's and Dalhousie colleges, held at Halifax, the joint committees unanimously arrived at a satisfactory basis of amalgamation for the federation of the various colleges in the maritime provinces, which will be submitted to the boards of governors of the various colleges for confirmation.

AT Yale University, Dr. Wesley R. Coe, instructor in comparative anatomy, and Dr. Milton B. Porter, instructor in mathematics, have been appointed to assistant professorships.

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, MARCH 28, 1902.

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THE INTELLECTUAL CONDITIONS FOR EMBRYOLOGICAL SCIENCE.

II.

NATURAL HISTORY AND NATURAL KNOWLEDGE.

THE definition of science as the analysis and classification of facts leads the philosophical spokesmen of modern science to believe that an embryological account of thinking men is impossible, because it leads them to believe there is a chasm which is intellectually impassable between the facts of physics and the facts of consciousness.

Since the minds and senses by the aid of which we make scientific discoveries are generated from eggs, the progress of embryological science must bring us around sooner or later to the old question: What is science? What is it to know a thing?

In this paper I shall show the fitness of biological science for helping us to reconsider this great question.

1. *May it not be that we understand a thing when we can tell what it means, and use it?*

Philosophers tell us we understand a thing *when we comprehend it,* but it is my purpose to ask whether the progress of biological science may not lead us to think, with Berkeley, that we understand a thing *when we can tell what it means and use it,* and whether this definition of science may not help us out of the paradoxes of philosophy, and make the way clear for an embryological account of thinking men.

2. *The problem of knowing.*

Our sensations and thoughts and feelings have not taken place anyhow and at random. They have been so related in the past that one has been a sign which has led us to expect others, which have always come about as we expected if our knowledge has been sound and accurate.

When they have thus come about, we have known that *this has not been our doing.* We have known too that it is because it has not been our doing that natural knowledge has been useful to us.

One of the most practical questions that man can ask is this: When, and how far, is our experience a sound basis for confidence in things that we have not experienced—such things, for example, as the animal life of the Cambrian sea, the molecular constitution of matter, and my own embryonic history? Since an answer to this question has been included in past knowing, it must also be included in an account of knowing. It is this question that physical science undertakes to answer by scientific discovery, but the biologist must ask a still more difficult question: How do living beings come to do unconsciously, and without knowing it, the things that are to their advantage? How does a living being get safely through all the chances and changes of life without needing to run its nose into every danger before it avoids it? How do some men learn, from a single experience, what others fail to find out after a lifetime of experience?

3. *Our biological education begins at an early day.*

No institution, no period in the history of science, no stage in intellectual development, can lay claim to the beginnings of biological science. They are to be sought long before our entrance into laboratories; long before the beginnings of book-learning. Even before we learned articulate speech, the teacher whom the poet has called the grand old nurse took us upon her knee and began the wonderful story of nature for our delight and profit and instruction; that story to which there is no end; in which each chapter, as fresh and new as the first, adds new meaning, new usefulness to all we have been told.

Part, at least, if not the whole, of our early education was biological. We laid the foundations of anatomy and experimental physiology when we learned, through repeated scientific experiments, that it is through eyes that we see, through ears that we hear, through hands that we touch, and that it is good to see and hear and handle things. We were no doubt led, slowly and gradually, through innumerable scientific experiments, to the discovery that, among the changes that go on in nature, some are of peculiar interest and importance to us; and we thus come to set apart in our minds, from among the things of which our senses tell us, certain ones which seem, because of their clear relation to our comfort and discomfort, and because of the quickness with which we learn how to make use of them, to pertain to ourselves, and to constitute our bodies, as distinct from the world around us, which we are thus led to set over against ourselves, as a not-self. It seems to me that it is in this way that we lay a foundation, in the conception of a living body, for all later study of biological science, and no naturalist can doubt the great and permanent value of this conception; yet there is no more fruitful source of paradox and contradiction and absurdity than the words in which we attempt, at a later stage, to describe this scientific discovery; for while a scientific discovery is part of the language of nature, our words are, unfortunately, an inheritance from the language of scholasticism.

4. *Education is often unconscious.*

One may be educated without knowing it. The teacher who guides instead of driving is nearest the method of nature. The best of all training is that which is acquired with least effort, and some of the choicest fruits of intellectual activity have come when effort and self were lost in the inspiration of creative genius.

The untrained muscles of the infant are educated through exercise, but it is not in self-consciousness that the child and the kitten and the colt and the calf delight in frolics and gambols and sports and games. It is only after the human infant has spent weeks in experimenting that it acquires the useful art of moving its eyes together, and of seeing objects single and solid, instead of flat and tremulous. I do not know whether the child is conscious or unconscious of this lesson in the physiology of vision, but it is, assuredly, not through induction from particulars and deduction from laws that the nutritive and nervous changes come about, through which the muscles of the eyeball become coordinated, yet these are educational changes. So far as education is shown by doing the things that are advantageous, and in avoiding those that are injurious, the ancestral rhizopod, which extends its pseudopodia under the stimulus of fit food, and retracts them on the approach of danger, is educated, for our biological education begins long before our birth, and we are born educated. It is this truth, no doubt, which has led some to the strange notion that life is memory.

5. *The things we do most easily, or most naturally, are not always the wisest things.*

The history of our minds, like that of our bodies, has been such that the things we do most naturally are not in all respects the best for our present needs. Just as there are bodily parts which, while fitted for past conditions, are no longer useful, and just as we have natural impulses and appetites which now call for repression, so it is also with our minds; for we are in continual danger of a logical fallacy which it is the peculiar work of natural science to correct, since it is an incidental result of our natural history. This is the fallacy known to logicians as the fallacy of the undistributed middle—the fallacy which consists in mistaking a part for a whole.

6. *The fallacy of the undistributed middle is constitutional.*

Our bodies are so constituted that an action which is at first performed with difficulty becomes easier with each repetition, while departure from established custom at the same time grows harder. It is this peculiarity which fits our bodily frame for improvement by practice and training. In this, our minds are like our bodies, for a path which our thoughts have once traversed becomes easier with each new venture, while it grows harder for us to consider what lies beyond the borders of this path.

The facts of nature do not all interest us equally. Some are more attractive to us than others, and we must specialize to make progress in knowledge, so we are continually and unconsciously fixing attention upon some part of nature, for some purpose of our own, and considering it 'in itself,' to the neglect of that which does not interest us, nor seem to concern us.

Our minds, as they have come to us in course of nature, are so constituted that, when we consider a part as if it were the whole, we are in danger of forgetting that it is but a part and not the whole; and if we make this mistake, we may be led into opinions which seem to be the logical conclusions of sound reasoning when they are nothing more than new illustrations of the threadbare fallacy of the undistributed middle.

7. *Philosophical agnosticism comes from mistaking a part for a whole.*

When, for some purpose of our own, we become interested in a part of nature, neglecting, for the time, as of no interest to us, its interrelations with other things, we may fall unconsciously, from the very nature of our minds, into the belief that what we have treated as if it were independent of the rest of nature, and complete in itself, is really independent and complete. Thus we come to regard mental abstractions as independent things, and then, finding that our abstractions have no independent being outside our minds, we ask the absurd question whether the real world of nature is anything but an abstraction and a chimera of our fancy, and set ourselves to making systems of philosophy to pull us out of the quagmire of agnosticism into which we think we have fallen.

Berkeley shows that it is because we call all sheep and all crows and all triangles and all numbers by generic names, that we think we can know a generic sheep and a generic crow and a generic triangle and a generic number—that is, a sheep and a crow and a triangle and a number which are not individual and particular sheep and crows and triangles and numbers; and he believes that it is nothing but language which makes us so ready to mistake abstractions for independent things, and then to think that because no real thing exists abstractly we can never know anything as it really is; and he shows that 'we need only draw the curtain of words to behold the fairest tree of knowledge, whose fruit is excellent, and within the reach of our hands.' So firmly rooted in our minds is the notion that abstract words stand for *things as they really are,* that Berkeley, who only asks us to use our utmost endeavors to obtain a clear view of the things we would consider, 'separated from all that dress and encumbrance of words which so much contributes to blind the judgment and divide the attention,' is commonly held to deny the reality of *things,* because he denies that any real thing exists abstractly.

Tyler traces our habit of mistaking abstractions for independent things, and the doubt of the reality of *things* which arises in the mind of the philosopher when he discovers that no real thing exists abstractly to the primitive culture of savages, and it is, no doubt, because there is still much of the savage in us all, that we try to distinguish the appearance of things from those things in themselves of which the appearances are thought to be the ghosts.

May we not trace still farther back the habit of mistaking abstractions for independent things, and ask whether it may not be an unfortunate incidental result of that fitness of living beings for education which is older than the trilobites?

It is not the value nor the reality of generalizations, but their independent, or abstract, reality, that is called in question. A generalization is as real as a pain, and, like a pain, it may have the greatest value, and call our attention to other real and important things which might have escaped notice, and it may thus help us to foresee or direct nature.

If the pain were not my pain it would not be at all; yet, while its being is relative to me, this relation to me is not all the being it has. No fact is more certain than that I do not make my pain, for if it were my doing it could not call my attention to unnoticed things, nor have any value as a warning of danger. Is it not ignorance of this simple truth which has led some to think that our pain is our own doing, and that we need only stop doing it to make an end of it?

All I know about the trilobites and the moons of Jupiter is relative to me; yet the trilobites were real millions of years before any naturalist knew them, and the moons of Jupiter would, no doubt, still be real, even if all life should come to an end upon earth.

8. *Our bodies are real, but their reality is in their interrelations with our environment.*

The child's discovery that its body is of peculiar interest and importance to it, and peculiarly within its control, is a real scientific discovery. Living things are real things, and we can never know too much about them; but their reality is in their interrelations with the rest of nature, and not in themselves, nor in their relations to us. Surely this is good sense and good science. No physiologist who studies the waste and repair of living bodies, no naturalist who knows living beings in their homes, no embryologist who studies the influence of external conditions upon development, can, for an instant, admit that living beings are self-sufficient or self-sustaining, or that their being is in themselves; for the line we draw, for better study, between living beings and the external world, is not one that we find in nature, but one that we make for our own purposes.

The external world of a living thing is as much a part of it as its histological structure. If the environment of its body, or of any cell within its body, were different, neither cell nor body would be what it is, and if they had no environment they would not be at all, for neither eggs nor seeds nor desiccated rotifers exist abstractly. A self-sufficient and self-contained living thing is as fabulous as a griffin or a centaur, but no naturalist thinks for an instant that this truth casts any doubt upon the real existence of living things.

If the being of a living thing is in its interrelations with the world around it, as Berkeley tells us it is, and not in its interrelations with us, as the philosophers tell us it is, is it not clear that we can never hope to know all there is to know about it? But is it not equally clear that, so far as we do know it, we know it as it is?

Does the responsibility for the notion that we can never know a living being as it really is rest upon the shoulders of the naturalist who knows that its being is dependent and relative? Is it not rather to be laid to the charge of the philosopher who believes in its abstract or independent existence, and is led to doubt its reality by the discovery that abstractions have no independent existence?

Locke reminds us that "we see and perceive some of the motions and grosser operations of things here about us, but whence the streams come that keep all these curious machines in motion and repair, how conveyed and modified, is beyond our notice and apprehension; and the great parts and wheels, as I may say, of this stupendous fabric of the universe may, for aught we know, have such a connection and dependence in their influences and operations one upon another, that perhaps things in this our mansion would put on quite another face, and cease to be what they are, if some one of the stars or great bodies, incomprehensibly remote from us, should cease to be, or to move, as it does. This is certain: things, however absolute and entire they seem in themselves, are but retainers to other parts of nature, for that which they are most taken notice of by us. Their observable qualities, actions and powers are owing to something without them; and there is not so complete and perfect a part that we know of nature, which does not owe the being it has, and the excellencies of it, to its neighbours; and we must not confine our thoughts within the surface of any body, but look a great deal farther, to comprehend perfectly those qualities that are in it."

9. *The being of things is real, but is it in themselves, or in their interrelations?*

Is it as a self-contained and self-sufficient being, or as part of the universe, that the stone illustrates the law of gravitation?

When Sir Isaac Newton made his speech about the child and the pebble: "Did he mean," asks Dr. Holmes, "to speak slightingly of a pebble? Of a spherical solid which stood sentinel over its compartment of space before the stone that became the pyramids had grown solid, and has watched it until now! A body which knows all the currents of force that traverse the globe; which holds by invisible threads to the ring of Saturn and the belt of Orion! A body from the contemplation of which an archangel could infer the entire inorganic universe as the simplest of corollaries! A throne of the all-pervading Deity, who has guided its every atom since the rosary of heaven was strung with beaded stars!

"The divinity student honored himself by the way in which he received this. He did not swallow it at once, nor did he reject it; but he took it as the pickerel takes the bait, and carried it off with him to his hole (in the fourth story) to deal with at his leisure."

10. *May not the notion that our minds are in our heads be due to the fallacy of the undistributed middle?*

Our welfare and our existence depend upon the soundness and safety of our brains, and knowledge of real brains and their functions is of the utmost value and importance, but would it have any value if, knowing only the appearance of brains in our minds, we were altogether put off with false appearances, and could never know brains as they are in themselves?

If the being of a living brain is not in itself, but in its interrelations with nature, we do know brains as they really are when we discover these interrelations; but if the being of a brain is not absolute and independent, but dependent and relative, what are we to think of the notion that our minds are shut up inside our heads? May not this also be an illustration of the fallacy of the undistributed middle? My mind to me a kingdom is, but I find no reason to think this kingdom is a microcosm—a little world set over against the great kingdom of nature. My kingdom is the great universe itself, the starry heavens, and the geological history of the earth, and everything else I know, and my mind grows as more and more of nature becomes mine by right of discovery. So far as I know the Ichthyosaurus and the rings of Saturn, these things are in my mind; and if the things I know were really shut up in my skull, these things would be inside my skull; but there is no room there for real whales and real megatheriums, so philosophers tell me I can never know anything as it really is, because the only universe I can think of or consider is the one I know.

Stone walls do not a prison make, nor iron bars a cage. May we not owe to the fallacy of the undistributed middle—to our useful ability to fix our attention upon a part of nature, and to temporarily neglect that which does not for the time interest us nor seem to concern us, and to the carelessness which permits us to think that what we have considered by itself for our own purposes is really self-contained and self-sufficient—may it not be to this that we owe the notion of a mind shut up in a head, and knowing nothing but the dissected and distorted shadows which the unknown and unknowable real world casts on the walls of its prison through its narrow and grated windows?

11. *Illusions and hallucinations do not show that the world I know is unreal, nor do they show that its reality is relative to me.*

Deceptions and illusions and hallucinations are not unreal. They are matters of fact of which the physiologist and the pathologist and the physician are finding out the meaning, and finding too a way to make use of this meaning, by scientific discovery, while common folks mistake their meaning, just as we mistake the meaning of other matters of fact when we think we know more than we have found out.

Comprehension is the gathering in of generalizations into a hypothesis, but while any plausible hypothesis may satisfy idle curiosity, it has no scientific status unless it leads to the discovery of facts and the control of nature.

When the ignorant man who has lost his foot feels the sensation which he has learned to call pain in his toes, he says his foot is uneasy in its grave. When the learned philosopher tells him his pain is an illusion, he may justly declare that he knows his own feelings better than any one else, however learned. The pain is real, but when he satisfies himself with the notion that his foot is uneasy, he mistakes a hypothesis for a fact, like the philosopher, while the man of science discovers that the sensory nerve is irritated somewhere else than at its endings in the toes.

12. *Instead of showing that we can never know anything as it really is, may not the notion that knowledge is comprehension be a new illustration of the fallacy of the undistributed middle?*

We comprehend things when we know them, but it does not follow that when we comprehend them we know them, for knowledge may be comprehension and something more.

The resemblances between things are summarized by classifying or comprehending them, but Locke has reminded us that knowledge is the discovery of resemblances *and differences.* So far as we know nature, it exhibits universal order in endless diversity; not order here and diversity there, but order in diversity. Can we know any two things are alike without knowing they are different? We may, for some purpose of our own, fix our attention upon the order of nature, neglecting the diversity, but things do not cease to be because they do not, for the time, seem to concern us.

Are the order of nature and the diversity of nature either two things or one thing seen from two standpoints? Are they not rather two narrow and imperfect views of the natural world which lies before our eyes? Have we any way to find out either the unity of nature or the diversity of nature except scientific discovery? May not the notion that while we discover the laws of nature, we deduce from these laws the diversity of nature, and our control of nature, be an illustration of the fallacy of the undistributed middle? Is a scientific law anything more than a summary of past experience, *joined to confidence in the continuity of nature?* Do we ever know that we can foresee or control nature, even in repeating the simplest scientific experiment, until we have succeeded?

13. *Biological science is peculiarly fitted for calling to our attention the diversity of nature.*

While analytical science is making marvellous revelations of the order which pervades the apparent disorder of nature, showing us, by the method of analysis and generalization, the most astonishing proof of order and regularity in the course of events which had seemed to be chaotic, biological science is continually recalling to our attention the diversity of the statistical data, and making equally marvellous and equally instructive, revelations of the inexhaustible variety of nature. We talk about humanity, but we know and deal with Peter and Henry and Thomas and Black Jim and Yellow John. We need proper names for all the animals that we are well acquainted with. The zoologist tells us about the genus *Equus*, but if he has any practical dealings with horses, he never says one horse is the same as another, or even that a horse is the same to-day as he was yesterday, for even if he be neither sick nor lame nor hungry, he is one day nearer the end of his usefulness.

The botanist talks learnedly of *Chrysanthemum indicum*, but the florist sells golden wedding and ivory and fair dawn and snow queen and hundreds of others. For many scientific purposes it is necessary to give proper names, or designating numbers, to seedling plants, and it may be that if the chemist were dealing with individuals, instead of averages, he might need proper names to tell to others his discoveries about molecules and atoms.

14. *Are identity and diversity absolute or relative?*

To-day's sun is the same as yesterday's, yet the changes which go on in the sun, from day to day, are, no doubt, violent and rapid beyond our utmost means of measurement or expression. We say to-day's sun is the same as yesterday's when we are interested in the dawn and the daylight, and in the flight of time, and in the change of seasons, and in the transit of Venus, and in the stability of the solar system; but we say it is not the same when we are interested in sun-spots, and in the fall of meteorites, and in combustion and the dissipation of energy. When we say the solar system is stable, we do not mean that it is really stable. We only mean that the course of its progress from some past condition to some future condition has no obvious practical relation to our own affairs.

We seldom lose sight of the diversity, or individuality, of familiar living things in our interest in their resemblances. We do not say one horse is the same as another between the shafts. We say he is as good as another, or will serve, or that he is the same *substantially*, meaning, by these words, the *same substantially*, or *the same in substance*, that, while he is not the same, we will accept him as a substitute; but no one with worldly wisdom trusts the strange horse, even so far, before he has tested his opinions, and those of the horse dealer, by scientific experiment and verification.

Biological science has peculiar fitness for guarding us from the fallacy of the undistributed middle, and for teaching us that it is only through verification that guesses become knowledge, because its subject matter lies midway between those 'exact' sciences in which we are told that figures cannot lie, on the one hand, and, on the other, those social and political sciences which show us continually how easily one may lie with figures. When we have verified a hypothesis so often that we are 'satisfied,' we call it a 'law of nature,' and we build as firmly upon it, and trust to it as implicitly, and govern our actions by it as unhesitatingly, as if it were certain, and in all that concerns our conduct we make little or no difference between it and certain knowledge. In this, experience is continually demonstrating our wisdom, but if the discovery that hypotheses have no independent existence leads us to believe that we can never know the real world of nature, is it not time to reexamine our notions?

The laws of nature are real, but their reality is not independent nor absolute, because the unity of nature is unity in diversity, and diversity in unity.

If the views that are here advanced—views that are in no way original with me—are accepted; if the reality of the natural world is in the interrelations between things, and not in unknown and unknowable things as they are in themselves; does it not follow that scientific discovery is the only way to learn the differences between things, just as it is the only way to learn the resemblances between things? When we say two things are the same, must we not also say what are the relations with reference to which they are the same? When we say they are different, must we not also say what are the relations with reference to which they are different? Is there any way except scientific discovery to find this out?

15. *The biological problem of species.*

Fifty years ago many naturalists thought that all living things of a kind are fundamentally and absolutely alike in certain specific characters, and that it is only in characters that are not specific that they differ; but more exact study has failed to show us, in any living being, any characteristic whatever which does not exhibit diversity from others of its kind, as well as resemblances; for the notion that certain characters are generic, while others are differential, is an illustration of the fallacy of the undistributed middle, as is also the attempt to analyze living beings into *characters*.

After the long controversy between those who asserted the immutability of species, and those who declared that species are mutable, seemed to be happily ended by the scientific demonstration that species have a natural history, there arose a new school of naturalists, who asserted that species have no existence in nature because no two living beings are identical in any respect whatever. At the present day, many naturalists are returning to a modification of the old notion of species, and are teaching that while the mutability of species is due to changes in the interrelations between living beings and the world around them, stability is inherent in the living beings, *as they are in themselves* by birth.

If the view which is here advanced be correct, the specific stability of the individuals of a species is real, and as independent of us as the stability of the sun in the heavens, but when we say the individuals of a species are alike, we must also say what are the relations with reference to which they are alike, for the stability of species and the mutability of species are not two facts, nor the same fact from two points of view, but two narrow and imperfect views of the same fact.

Thus, for example, individual sheep are alike for certain purposes of the zoologist and the paleontologist. They are alike to the embryologist and to the anatomist, and to the physiologist, so far as these scientific students are not concerned with their differences. They are, no doubt, alike to the hungry wolf, and to the geese that graze in the same pasture—to their competitors and enemies in the struggle for existence. They are alike in their sexual affinity, so far as there is no sexual selection. They are alike in the physiology of reproduction, and in their physiological activity in general, so far as they do not differ in fertility and in constitution. On the other hand, they are different to the stock-breeder, and to the shepherd, to the shepherd's dog, to their lambs, and, no doubt, to each other.

As we learn more about sheep, we learn more about their identity and more about their diversity, but this does not show that the identity and diversity are in us and not in nature. It only shows that neither the identity nor the diversity has any independent existence in nature abstracted from the living beings.

16. *Are inheritance and variation two processes, or two partial and imperfect views of the same process?*

If no two individual living beings are alike; if the stability of biological types means that the aberrant have been exterminated in the struggle for existence, and if the modification of a type is an indication of a change in the standard of extermination; are not inheritance and variation two partial and imperfect views of the selective process? When the embryologist seeks in the germ for the material basis of inheritance, and for the mechanism of variation, is he not searching for something which has no independent existence? Must he not seek, in the interrelations between living beings and their environment, and not in the living beings *as they are in themselves,* for that of which he is in search? Do not they who think that natural selection must be supplied with the raw material by a mechanism for variation before it can *do* anything, both personify the selective process and forget the diversity of nature?

17. *Does physical analysis give an adequate account of the organization of living bodies?*

Physical analysis resolves organized beings into organs and tissues and cells and physiological units, but does this analysis give an adequate account of organization?

The bodies of two allied animals are alike in structure. They are composed of organs which are said to exhibit fundamental unity *behind* superficial diversity, for they are practically identical in history, and for most of the purposes of the anatomist and the physiologist and the zoologist. From this point of view, and from many others, they are identical in structure, yet the differences between them do not cease to be because they do not concern us, nor because they escape our notice, for while the identity is real and important and significant, it has no abstract, or independent, reality.

'Were the heart of one man,' says Maudsley, 'to be placed in the body of another, it would probably make no difference in the circulation of the blood, but it might make a real difference in the temper of his mind.' Does not the analogy of nature lead us to ask whether it might not be expected to make a difference in the circulation of his blood as well as in the temper of his mind? If our knowledge of hearts were as minute and individual as our knowledge of men, might we not need a proper name for each heart as much as we need one for each man?

If the interest of the histologist in the resemblances between the tissues of one animal and those of another leads him to lose sight of their constitutional differences, he is in danger of mistaking an abstraction for a reality, for while the scientific basis of histology in the resemblances between the tissues of one animal and those of another is real and significant, it has no abstract, or independent, reality.

"From the morphological standpoint," says Hertwig, quoting from de Vries, "we may properly regard the cell, apart from the organism, as an individual, but we must not forget that it is by abstraction that we do so. Physiologically the cell is an individual only when actually isolated and independent of an organism. From this standpoint, every abstraction is a blunder."

When we say a multicellular organism is a unit, must we not also say what are the relations with reference to which it is a unit? When we say its constituent cells are units, must we not also say what are the conditions with reference to which they are units? Have we any way to find these things out except scientific discovery?

18. *Is cell-differentiation inherent or induced?*

A thoughtful and distinguished naturalist tells us that while the differentiation of the cells which arise from the egg is sometimes inherent in the egg, and sometimes induced by the conditions of development, it is more commonly mixed; but may it not be the mind of the embryologist, and not the natural world, that is mixed? Science does not deal in compromises, but in discoveries. When we say the development of the egg is inherent, must we not also say what are the relations with reference to which it is inherent? When we say it is induced, must we not also say what are the relations with reference to which it is induced? Is there any way to find this out except scientific discovery?

19. *Are the beneficial effects of practice and training and education and opportunity innate or superadded?*

Can we hope to answer this question, *a priori,* by deduction from hypotheses? Is there any more value in Weismann's demonstration that acquired characters cannot be inherited than there is in Haeckel's declaration that the inheritance of acquired characters is a necessary axiom of the monistic creed?

Such facts as are in my possession seem to me to show that, while we need opportunities to make the best of our natural abilities, no one can do his part in any station in life without natural aptitude. As my opinion is not a deduction from a hypothesis, I hold it lightly, and subject to revision and correction.

20. *May not the biological notion of a living substance be an illustration of the fallacy of the undistributed middle?*

When we say all living things are alike in substance, I cannot discover that we mean anything more than we mean when, admitting some report of a conversation as a substitute for the truth for some purpose that we have in view, we say it is the same in substance as the original conversation.

The modern naturalist is so well aware of the endless diversity of living things that he never—that is, hardly ever—thinks that because one amœba, or one yeast-plant, or one horse, will serve certain purposes of experiment, and demonstration, and instruction, as well as another, they are alike in any respect whatever.

21. *Conclusion.*

As my only purpose is to do what I can to make the way clear for the progress of embryological science, by trying to free my own mind, and the minds of others, from all notions which imply that embryological science is impossible, and not to give a natural history of mind, I have passed by many important aspects of human knowledge without notice. But, before I close, I ask you to take away with you, and to consider, this familiar fact: Philosophers tell us we may come at truth by deducing it from certain first principles which are self-evident to the normal man, and they talk about the normal man as if he were a prominent citizen, the familiar acquaintance of all who have any claim to be considered men of intellect, and a well-known face even to the common herd. The naturalist declares he knows no such person, that all men are individual and particular men, and the normal man a fictitious character, and a statistical average without opinions.

If the naturalist is honest with himself, it seems to me that he cannot fail to come in time to hold his most cherished convictions subject to revision, and to value them only when they are verified by laying them alongside nature, and to regard absolute truth and necessary truth as meaningless words, because the being of things is not absolute but relative to everything else in nature.

The truth that knowledge is not absolute, but relative, is held to be the final and conclusive proof that we can never know anything as it really is, for we are told that the reality behind the phenomena of sense must be unknown and unknowable, because we can never come at absolute truth. But may not the naturalist be moved to ask whether the conclusion follows from the premises? May it not prove to be only the final transformation of the protean fallacy of the undistributed middle? Instead of showing that we can never know anything as it really is, may not the relativity of knowledge show that nature, as it really is, is relative and dependent—that its being is not in itself? "As no man fording a swift stream," says Huxley, putting into vigorous English a thought that has often found expression; "as no man fording a swift stream can dip his foot twice in the same water, so no man can, with exactness, affirm of anything in the sensible world that it is. As he utters the words, nay, as he thinks them, the predicate ceases to be applicable; the present has become the past; the 'is' should be 'was,' and the more we learn of the nature of things, the more evident is it that what we call rest is only unperceived activity. Thus the most obvious attribute of the cosmos is its impermanence. It assumes the aspect not so much of a permanent entity as of a changeful process, in which naught endures save the flow of energy and the rational order which pervades it."

Every reflective student will, no doubt, feel a responsive chord vibrating in his own thoughts in unison with those of Huxley; but should he not ask himself whether the words, '*flow of energy and the rational order which pervades it,*' mean anything, except that the reality in which the flowing river of nature endures and has its being is rational energy, the energy of a reason, the activity of a mind?

Biological science seems to me to show, with ever-increasing emphasis, that it is in one sustaining mind that we ourselves, and all we know, or can hope to know, have being. Even if this be neither absolute truth nor necessary truth, may it not be that still better truth, a scientific discovery; and the greatest of all scientific discoveries because it has, so far, been verified in every act of knowing?

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THE NATURE OF NERVE STIMULATION AND OF CHANGES IN IRRITABILITY.*

As the conclusions of this paper supplement those of Professor Loeb, and as he is unable at present to publish an account of his work simultaneously with mine, a brief statement of the relationship of our work appears to us both to be desirable.

It is well known that Professor Loeb has for the past several years been applying the conclusions of physical chemistry in the investigation of the phenomena of life, as he was convinced that these conclusions would clear up many physiological phenomena. Of the several discoveries which have rewarded his insight there are two of apparently the most fundamental nature. One of these was made several years ago and published in *Fick's Festschrift* in 1899. It consisted in the demonstration that muscle would only beat rhythmically in solutions of electrolytes. This practically established the fact that contractility was in its essence an electrical phenomenon. About two years ago he expressed to me the opinion that other life phenomena were electrical, and not chemical or thermodynamical. A second fundamental generalization was made last summer at Woods Holl and published in *Pflüger's Archiv,* Volume 88, 1901, to the effect that the toxic and antitoxic action of salts was a function of the number and sign of the elec-

* This paper was prepared for publication early in January, but has been delayed in its appearance.

trical charges their ions bore. During the summer, and later in a lecture before the Medical Society of the University of Chicago, he applied these results to the action of toxines and antitoxines. He was, however, unable to discover any series of facts for the anions similar to those he established for the kations, and he referred the poisonous action of a pure sodium chloride solution to the monovalent kations the salt possessed instead of to the anions. In his work on muscle, also, the stimulating action of sodium chloride was referred to the sodium ions and I provisionally adopted the same explanation in my preliminary paper on the action of salts on nerves published in the *Journal of the Boston Society of Medical Sciences* last spring. Professor Loeb's attention was thus drawn chiefly to the kations. He attributed the undoubtedly greater stimulating action of the bivalent and trivalent anion sodium salts to their calcium-precipitating properties, having been brought to this conclusion by the peculiar action of fluorine.

In 1897 Professor Loeb directed my attention to physical chemistry, and his results on muscle appeared so remarkable that I began, three years ago, a study of the stimulating action of salts on nerves. The relationships were so complex that a long series of observations were necessary, but, during the spring of 1901, I published a preliminary paper in which, owing to incomplete results, I fell into several errors. The stimulating action of the higher anions was provisionally referred to the hydroxyl ions the solutions generally contained, and the peculiar activity of sodium compounds to the diffusion of Na ions into the muscle.

Further experiments showed me that certain of the conclusions were wrong. After reading Hardy's paper on 'Colloidal Solutions' and hearing Professor Loeb's lecture on the possible importance of the valence of ions, and more particularly of the kations, in determining their poisonous character, I had the opportunity of putting together my experiments. After computing the degree of hydrolysis and the number of H and OH ions in the solutions, it appeared that it was not the OH ions which were the cause of the stimulating action of the borates and citrates. The resemblance of my results to those of Hardy on colloidal solutions was apparent, and, apart from certain exceptions left for future investigation, I was led to infer that stimulation was due to the negative ions, and that the positive ions prevented stimulation; and also that as the stimulating action of the anions generally increased with an increase in valency, the stimulation was due to the electrical charges the ions bore. Following out this idea, which, as will be seen, was the extension of Loeb's idea of the importance of valence, the electrical relationships of nerves, the nature of stimulation and of changes in irritability and the nature of the nerve impulse appeared in a new light. The main results and conclusions were presented before the Medical Society of this University on December 2.

Meanwhile, unknown to me, Professor Loeb had begun to doubt that the calcium precipitation by the higher anions was the real cause of their action. Upon hearing my results and conclusions he perceived that they agreed with his facts as well.* It is with gratitude that I acknowledge my indebtedness to Professor Loeb, who showed me in which direction to look and who as a pioneer has opened one of the most fruitful fields of science. My own conclusions supplement and, it seems to me, make more precise those general ideas which were guiding him.

* Since this paper was sent to the editor, Professor Loeb has published in the February number of the *American Journal of Physiology* a portion of his results on muscle.

My observations were made on the sciatic nerve of the frog and stimulation of the nerve was shown by the contractions of the gastrocnemius muscle. I have tried about nine hundred experiments on frogs at different seasons of the year, so that the observations are numerous enough to offset most individual variations. The nerves were immersed for the greater part of their length in the solutions to be tested.

1. Nerves are stimulated by the withdrawal of water. The non-electrolytes sugar, urea and glycerine will stimulate if the osmotic pressure of their solutions is equal to, or greater than, twelve atmospheres. This is more than twice the osmotic pressure of the nerve. Nearly all electrolytes tested, quite irrespective of their nature, will also stimulate if their solutions are as concentrated as this. The nerve always increases in irritability (katelectrotonus) before impulses large enough to cause the muscle to contract are generated. After complete loss of irritability in the non-electrolytes the nerves will be completely restored by placing them in M/8 sodium chloride solution. These facts demonstrate anew the truth of the generally accepted opinion of physiologists that the change in the nerve which generates the nerve impulse can be set up by the withdrawal of water.

2. All salts of H, Li, K and NH_4 which were tested of which the anions are monovalent, such as KCl, KBr, KI, LiCl, NH_4Cl, and others; all salts of bivalent kations united to monovalent or bivalent anions, such as $MgCl_2$, $MgSO_4$, $Mg(NO_3)_2$, $ZnCl_2$, $ZnSO_4$, $BaCl_2$, $Ba(NO_3)_2$, $CuSO_4$, $SrCl_2$; all salts of trivalent kations united to monovalent anions, such as Fe_2Cl_6 and Al_2Cl_6 will generally stimulate if their solutions have an osmotic pressure of twelve atmospheres or over. In solutions weaker than this they all annihilate nerve irritability without stimulation, H, K and Fe_3 salts most rapidly. Irritability may generally be restored, if the nerves are not left too long in the solutions, by immersion in M/8 NaCl solutions. All these salts, therefore, stimulate by withdrawing water. The salts themselves will in each case destroy irritability.

3. All acids tested with the exceptions (possibly) of phosphoric and oxalic will not stimulate, except in solutions of high osmotic pressure (twelve atmospheres) Hydrogen ions do not appear hence to stimulate the nerve. On the contrary in weaker solutions tested, nerve irritability was lost without stimulation. This confirms Grützner and others. My experiments, however, are not complete on this point.

4. Alkalies such as NaOH, LiOH, KOH, $Ba(OH)_2$ will stimulate in approximately N/20 solutions. The hydroxyl ion, in other words, at certain concentrations stimulates the nerve.

5. If we compare the stimulating action of NaCl, NaBr, and NaI we find that these salts stimulate even in solutions of the same osmotic pressure as the nerve. The stimulating action of the salts increases as we pass from the chloride to the iodide. Hence stimulation is in some way a function of the anion, because the rate of diffusion of these salts is approximately the same and the number of Na ions is constant. It is not a function of the atomic weight, since the fluoride stimulates more than the chloride or iodide. These observations confirming Grützner led to the conclusion that the stimulating action of salts is due to their anions. On comparing the action of Na_2SO_4, $Na_2C_2O_4$, Na_2HAsO_4 and other bivalent anion salts we find that these are more powerful than the monovalent anions; and the trivalent anion salts such as sodium ferricyanide, sodium citrate and Na_3PO_4 are still more powerful than the bivalent anion salts. Thus NaCl and NaBr

will stimulate slowly in solutions of one gram molecule to 8,000 c.c.; Na_2SO_4 in one gram molecule to 25,000 c.c.; and Na_3 citrate in solutions of one gram molecule to 50,000 c.c. The power of stimulation as indicated by the prolonged tetanic and simple contractions of the muscle extending over hours is also greater than that of the monovalent salts. These observations clearly support the inference that stimulation is a function of the anions and also establish the fact that it is a function of the charges the ions bear. They thus support Loeb's general idea that valence or the electrical charges of ions determine their physiological action, but demonstrate that it is the negative ions which stimulate. As will presently be shown, however, valence, as such, possibly has no direct influence, but only indirectly determines the action of these ions.

6. The conclusions just drawn led me to infer that the positive ions must prevent stimulation and render the nerve non-irritable. This is shown to be the case by a comparison of HCl, LiCl, KCl, NH_4Cl and NaCl. The last salt stimulates; in the others the chlorine ion will not stimulate and the nerves lose their irritability. This can only be explained, I believe, by assuming that the stimulating action of the chlorine ion is overbalanced by the non-stimulating action of the positive ion, and of these positive ions it appears that H overbalances most, K less, Li still less and NH_4 least. If this idea is true it should be possible, by combining these positive ions with di- and trivalent more potent anions, to obtain a stimulating compound. This is indeed the case. KCl never stimulates except by the withdrawal of water; K_2SO_4 will occasionally stimulate the most irritable nerves in solutions of about the osmotic pressure of the nerve; K_3 citrate and K_3 ferricyanide will stimulate in solutions of a gram molecule to 22,000 c.c., of which the osmotic pressure is less than that of the nerve. The same is true for other salts. Li_3 citrate stimulates in a gram molecule to 30,000 c.c. and $(NH_4)_3$ citrate in a gram molecule to 40,000 c.c. We thus come to the conclusion that stimulation is due to the negative charge of the anions and that the kations prevent stimulation. It follows from this that the chemical properties of an acid or a salt are determined by the balance between the anion and the kation. In NaCl the ions are nearly equivalent, but the chlorine slightly overbalances. This idea of the mutual antagonism of the anion and kation may possibly throw light on chemical processes and properties generally.

7. $KMnO_4$, $NaMnO_4$, and $NaClO_3$ will stimulate in solutions of a gram molecule to 12,000 c.c. This stimulation is possibly due to the liberation of some bivalent oxygen anions.

8. These results are similar to those of Hardy and others on colloidal solutions. Colloidal solutions, the particles of which are positively charged are precipitated by OH ions and anions and the precipitating action of these anions is in proportion to a power of their valence. They seem to be held in solution by hydrogen and possibly other positive ions. As it is well known that protoplasm contains colloids in solution, a fact Hardy has particularly emphasized, it occurred to me that stimulation might be due either to a gelation of the colloids or to their passage into solution. Loeb has frequently mentioned his belief that a variation in the state of the colloids in protoplasm is of importance in protoplasmic activity and particularly irritability. He and others have repeatedly described processes of liquefaction of protoplasm, and several years ago he attempted to refer changes in irritability to an alteration in the viscosity of protoplasm. I infer that stimulation consists in a

passage of the particles from the solution to or toward the gel, and that if we can prevent gelation stimulation is prevented and irritability is lost. This is indicated by the following facts among others:

The nerve contains colloids. Colloidal solutions, the particles of which carry positive charges, are precipitated by negative ions. Nerve irritability is increased by cooling and diminished by warming. The stability of the hydrosol is probably diminished by cold and increased, like common gelatine, by moderate warmth. Also when coagulation by heat occurs the nerve is stimulated. Coagulation is but the formation of an irreversible gel. Darwin's observations on *Drosera* and other plants by optical evidence demonstrates also this gelation. Darwin observed in his work on 'Insectivorous Plants' that the passage of the impulse over plant cells, which corresponds to the nerve impulse in animals, was accompanied by a visible precipitation or gelation of the protoplasm, the nature of which he did not understand, but which he called aggregation. He states that the molecular change supposed to occur in nerves may thus actually be seen in plant cells. There can be no doubt that he was right in comparing this change to the nerve impulse. He found that it was produced most readily by the citrates and phosphates, and was checked by Ba, K and other such salts. Thus his facts correspond closely with those I have found for the nerve. Aggregation was prevented by ether, by CO_2 or lack of oxygen. It could be produced by the extraction of water. His description of the process leaves little doubt that he is describing the formation of a reversible gel. The aggregated particles afterwards dissolved. The action of anæsthetics and the electrical phenomena of the nerve also support the idea that stimulation is a process of gelation. This will be discussed later.

These facts indicate the truth of the following general statements:

I. Protoplasm consists essentially of a colloidal solution, the particles of which are positively charged. It is a reversible hydrosol.

II. Stimulation consists in the passing of the solution to or toward the gel. Irritability is reduced or abolished if we make the sol state more stable, or if gelation is complete. In other words, irritability varies inversely with the stability of the hydrosol.

9. Electrical stimulation. If stimulation is due, as I believe, to the negative charges the ions bear and is prevented by the positive, the identity of electrical and chemical stimulation is thus demonstrated. It makes no difference whether we put the negative charges into the nerve on ions or whether by touching the nerve with electrodes we bring about, so to speak, a surplus of positive charges at one pole and negative at the other. The end result is the same. It is thus plain why the stimulus begins at the negative electrode, or kathode. In this region by the action of the kathode, the negativity of the nerve is increased and gelation occurs. In what manner this negativity is increased will be discussed in the full paper, but it may be due indirectly to the hydroxyl ions. Electrotonus is also explained. By the passage of the current the negative charges are in excess or preponderate in their action near the kathode and positive charges preponderate near the anode. The stability of the hydrosol is diminished near the former and increased near the latter. Irritability is altered as just explained. These conclusions are supported by Hardy's observations on the movement of colloidal particles in the electric current and their precipitation at the kathode if positively charged. If the nerve is already near gelation (very irritable by cold or drying) we may have

gelation occurring sufficiently abruptly to cause tetanus during the passage of the current. A true condition of katelectrotonus may also be produced by taking water from the nerve.

10. The current of injury may also be explained on this hypothesis. At the cut end aggregation or gelation is taking place as a result of the disturbance of the mechanical conditions of the nerve. Here positively charged colloids are going out of solution and negative charges are temporarily set free. The cut end becomes negative to the uninjured portion. This conclusion is supported by the fact that warming the nerve locally causes the warmed portion to become electro-positive to the unwarmed, and cooling it causes the cooled portion to be electro-negative to the rest of the nerve. It is similar to what occurs when zinc goes into solution. The undissolved zinc becomes negative to the solution. It is also well known that if by heat we produce an irreversible gel (artificial heat section) of the nerve, the coagulated portion is negative to the rest.*

11. Mechanical stimulation may possibly be understood as follows: By the mechanical coalescence of the neighboring colloidal particles their surfaces become less than the sum of the surfaces of the separated particles. A portion of the negative charges formerly induced in the water surrounding each particle is accordingly set free. These immediately act like negatively charged ions and precipitate the next layer of colloids. The process may possibly be similar to that which occurs on jarring an unstable hydrosol or a supersaturated solution. The observations of Darwin and others show that jarring will bring about aggregation in protoplasm.

12. The nerve impulse may consist in the following process. By the precipitation of each layer of colloids negative charges are regenerated; these precipitate the next layer of colloids and are again regenerated, and so on. That something of this sort occurs is indicated by the following facts:

(*a*) Darwin's observation that the passing of the impulse in plant cells is accompanied by a progressive precipitation.

(*b*) The facts that negative charges are set free in the nerve by the action of each successive segment. These charges constitute the negative variation.

(*c*) The fact that negative charges precipitate positively charged colloids.

(*d*) The fact that negative charges stimulate the nerve.

(*e*) The fact shown by the action of ether and other poisons that the negative variation is not a simple movement of inorganic ions, but is dependent for its propagation upon the state of irritability (state of the colloids) of the nerve. This fact has already led many physiologists to infer that the negative variation stimulates each successive segment of the nerve and is regenerated by the change it itself has brought about.

13. The action of anæsthetics. This consists, on the hypothesis so far sketched, in increasing the stability of the hydrosol or solution, and so preventing precipitation. There can be no doubt that the anæsthetics have this action as is shown by the following facts: Darwin observed that they prevent the process of aggregation or precipitation in plant cells, and it has been shown by Loeb, Budgett, Zoethout and others that they liquefy or dissolve the cells of infusoria and other animals and egg cells. The effect of a mixture of ether and water on starfish eggs is remarkable. The egg dissolves in it very rapidly. Furthermore, Overton and Meyer have shown that the anæsthetizing action of substances is pro-

* The relation of this explanation to Waller's idea that the cut end is positive will be discussed in the full paper.

portional to their fat-dissolving powers. The colloids in protoplasm are in all likelihood fat or lecithin proteid combinations like the sheath of the red blood corpuscles, and like the latter they are, no doubt, more soluble in ether and water than in water alone. So far as I can see, this explanation of the action of anæsthetics is in harmony with the facts. It supports the general conclusions drawn as to the meaning of changes in irritability and it explains the often-noted similarity of action between hydrogen ions, certain poisons, potassium ions and the anæsthetics. All these substances increase the stability of the hydrosol and liquefy protoplasm.

14. Stimulation by light and ether vibrations. In paragraph 5 it was stated that, in my opinion, stimulation by the negative ion was not due primarily to the valence of the ion. It is not the charge itself, but its motion, which determines stimulation. This is shown, I believe, by the variation between the action of fluorine, chlorine, bromine and iodine, and between potassium, sodium and hydrogen. The hydroxyl ion, although monovalent, stimulates like a bivalent anion. Since the fact is apparently established that it is the electrical charge which stimulates, and not the atom with which it is associated, and also since the charge associated with chlorine does not differ in nature from that associated with fluorine, the difference in action between these ions can only be due to something the charge does; in other words, to the motion of the charge or of the atom with which it is associated. When a charge is moved it produces a disturbance in the ether. It is well known to all that the vibrations of the ether will produce those changes in protoplasm which the ions produce, and further the character of the change in protoplasm produced by light varies with the wave-length or the number of impacts per second. Violet light or the ultra-violet rays stimulate protoplasm, while the red rays as a rule do so very feebly or inhibit movement. By the electromagnetic theory of light the ether disturbances which we call light must be due to the movement of electrons or charges in the sun, either constituting a part of the sun's atoms or associated with these atoms. In other words, it is not the presence of the charges in the sun which stimulates protoplasm, but the movements of the charges.

These facts are ground enough for the hypothesis that it is not the charges or the number of charges, but the movements of the charge which produce the change in protoplasm called stimulation, and, I may add, which must determine chemical action as well. This idea will agree, I believe, with the suggestions of J. J. Thomson, Larmor, Nernst and others in regard to the association between atoms and electrons. This motion of the electron may be either translatory on the atom, which will agree with the kinetic theory of solutions, or it may be a rotatory motion. For various reasons I am inclined to assume that the charge is either revolving with the atom or about it, but a detailed consideration of this point will be given in the full paper. Knowing, however, that charges in motion affect the ether; that the impulses thus given produce chemical changes; that substances in solution or as solids actually give out what we call ether vibrations; having established the fact that monovalent ions differ among themselves in stimulating action, although the charges are the same on each, and also that ions stimulate by the charges and not by the atoms, I see no escape from the conclusion that it is not the charge, but its motion and its sign, which ultimately determines its action. In other words, chemical stimulation and light stimulation are identical.

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NODULES AND MOLECULES OF RED BLOOD-CORPUSCLES.

DESCRIPTIONS of human blood usually give the general form and dimensions and behavior of the red corpuscles, emphasizing the fact that mammalian blood in the mature condition is negatively characterized by the absence of nuclei. They fail, however, to note the presence of minute nodules, like excessively minute nuclei, one for each corpuscle as a general rule. These bodies, which are not always central in the corpuscle, appear under the microscope as dark rings, each with a bright, yellowish center. On first seeing them in coagulated human blood, I was puzzled by their being unexpected. Afterwards I found a row of them visible in profile along the edge of a layer of blood that had got bent up. In this case they were like minute mammæ, spherules protruding so as to show the yellow hue without a dark border. They soon came to be the best evidence of the presence of blood, being seen under the microscope at regular distances, as marking the component corpuscles of the clot; and they persist as the last recognizable parts of disintegrating blood.

Not being able to find any reference to them in our own language, I was directed by my colleague, Professor C. F. W. McClure, to an article on them by A. Negri in the *Anatomischer Anzeiger* of 1899, p. 33. That article referred to their discovery and description by Petrone of Catania in 1897; and reported an examination of human and dog's blood, comparing the nucleated condition of the red corpuscles of the fœtal blood with the non-nucleated condition in the adult. And after describing the form, aspect and position in the mature blood, of the bodies to which we may assign the name 'blood-nodules,' it described and figured a small body attached to the nucleus in the fœtal blood; adding that this is the body which after decay of the nucleus itself in mammals persists in the adult, and that it is not found in non-mammals.

After studying the account of Hæmoglobin, by Gamgee in the first volume of Schaefer's 'Text-book of Physiology,' I attempted to apply the results of the chemical work and the spectroscopic examination by recent authors to the problem of the molecular constitution of the blood corpuscle. According to Hüffner and others the hæmoglobin molecule is, chemically speaking, very large, numbering 16,669 as its molecular equivalent; and the explanation of this largeness is that it carries one atom of iron, which, being itself heavy, 56, requires a large vehicle, just as a gunboat is large because it is to carry a heavy cannon. The final cause of this arrangement appears to be that the molecule of hæmoglobin may insorb a molecule of oxygen gas, becoming specially associated with its atom of iron, in the form of FeO_2, receiving the charge of oxygen at the lungs, and afterwards discharging it into the tissues. This suggested the possibility of determining in an approximate way the absolute size of the molecule of hæmoglobin. I understand that this has not hitherto been done for any proteid; and the method here employed is general, and may be used wherever an organic substance combines in definite proportions with a gas.

Having measured the volume of the red blood-corpuscle, and taking 31 per cent. as its quantum of hæmoglobin, and 1.29 as the specific gravity (estimated from the whole corpuscle being about 1.09 sp. gr., of which 69 per cent. is water), I made out in milligrams the weight of the hæmoglobin for one corpuscle. Applying to this the well-established constant that one milligram of hæmoglobin insorbs 1.334 cubic millimeters of oxygen gas estimated at 0°C. and 760 mm. pressure, the product of these gave the volume of oxygen gas insorbed by the single corpuscle as its full charge. Nernst's 'Theoretische Chemie' (1900, p. 394) gives the most reliable estimate of the number of molecules of oxygen, or any other gas, in a cubic millimeter at standard temperature and pressure. This is 55 thousand millions of millions (which may be written 55TMM). Calculated from this, the oxygen taken in by the single blood corpuscle as a full charge is found to be about 28 hundred millions of molecules. But as the combination is known to be regularly one molecule of the gas to one molecule of hæmoglobin, this result, or in round numbers three thousand millions, is approximately the number of hæmoglobin molecules in the blood-corpuscle (3 TM).

Dividing this last number into the volume of the hæmoglobin in a corpuscle, we obtain the volume of the cubic 'room' assigned by chemists to each molecule, and the cube root of this will give the length of the imaginary walls of said room, also nearly the diameter of the molecule regarded as a sphere in a solid state. The volume is approximately $1/10^{17}$ cubic millimeters, and the linear dimension of the side of a molecule 'room' is about 1/500,000 of a millimeter. The 'rooms' of the oxygen molecules in the gaseous condition are much larger than these, because the gases rejoice in spacious apartments; in fact, the volume of gas which is insorbed by the blood is nearly twice as great as that of the devouring hæmoglobin.

Nernst states that by multiplying the absolute atomic weight of hydrogen upon the molecular formula of any proteid, we may obtain the absolute weight of the proteid. This involves, we think, the assumption that no condensation has occurred in building up proteid molecules. In order to test the rule by hæmoglobin, we find that this rule gives as the absolute molecular weight $1.35 \times (10)^{-17}$ of a milligram. By the method of the quantitative absorption given above of oxygen the value comes out as $1.30 \times (10)^{-17}$ of a milligram. The two results differ by less than 4 per cent. This close harmony does not prove that the estimated weight of the atom of hydrogen is right, for it enters into both methods; but it does prove non-condensation, and also confirms the quantitative results of Hüffner and others as to the absorption of oxygen. It may be added that the oxygen absorbed is, when estimated in its fluid form, about 1/470 the volume of the absorbing hæmoglobin.

But probably if the oxygen were examined in the liquefied or solidified condition, its molecular sphere of action would be found not to be so very widely divergent from its rightful proportion of 32 to 16,669.

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SCIENTIFIC BOOKS.

Leçons sur les séries divergentes. Par Émile Borel, maître de conférences a l' Ecole Normale Supérieure. Paris, Gauthier-Villars. 1901. Pp. vi+182.

La Série de Taylor et son prolongement analytique. Par Jacques Hadamard. Scientia, série physico-mathématique. Chartes, imprimerie Durand. 1901. Pp. viii+102.

These two works can appropriately be classed together, on account of both their authorship and their contents. Among the younger French mathematicians who have taken their doctors' degrees within the past dozen years none are to-day more conspicuous than Hadamard and Borel. Their theses were published in 1892 and 1894 respectively. A few years later both writers were recipients of prizes from the French Academy of Sciences. In 1896 Hadamard received the 'Prix Bordin' for his work on geodesics, while Borel won the 'Grand Prix des sciences mathématiques' in 1898 for his investigations upon divergent series. Recently also they have been bracketed in a list of nominees to fill a vacancy in the Academy of Sciences.

We have here to consider two representative works. Each has the special interest that it is devoted to that branch of the theory of functions in which its author first attained distinction. Hadamard aims to give a concise, almost an encyclopedic, résumé of the present state of our knowledge concerning the analytic continuation of Taylor's series. Borel, on the other hand, gives a more detailed exposition of a single chapter of this subject, the divergent series. On this account his book will have the greater interest for the mathematical public and will be reviewed at somewhat greater length.

Two other works of equal size and somewhat similar character have been previously published by Borel, his 'Leçons sur la théorie des fonctions' (treating the 'Eléments de la theorie des ensembles et applications') and his 'Leçons sur les fonctions entières.' Together with the present work they form a unique series, embodying the results of much recent investigation in the theory of functions. It is indeed a piece of rare good fortune in any province of mathematics to have the important recent work thus promptly picked out and thrown into accessible form by such a mathematician as Borel. For this reason the publication of these lectures cannot be too warmly welcomed.

It is safe to say that no previous book upon divergent series has ever been written. Borel opens up a field of research which is still very new and promises rich reward to the investigator. In the process of evolution the divergent series has passed through several curious stages of development. At first a divergent series was accepted on faith and used with great *naïveté*. Thus Leibnitz, for example, when considering the expansion of $1/(1+x)$ into the series $1-x+x^2-x^3+\ldots$ remarks that if $x=1$, the sum of n terms takes alternately the values 1 and 0, and the sum of the series must therefore be equal to the mean value $\frac{1}{2}$. After the introduction of exact analysis by Cauchy and Weierstrass such a loose mode of treatment could no longer be tolerated. The mass of inconsistencies to which it would lead was clearly perceived, and a divergent series was therefore considered by the mathematician to be meaningless, good for nothing but to be thrown away. However, a few of the great mathematicians were visibly perturbed over the situation. Thus we find Cauchy complaining in 1821:

"J'ai été forcé d'amettre diverses propositions qui paraîtront peut-être *un peu dures;* par exemple, qu'une série divergente n'a pas de somme."

We know also that Abel was only prevented by his premature death from attacking the problem. But the view that a divergent series had no place in mathematical analysis soon became orthodox, and search after a legitimate basis for its use was abandoned. Nevertheless the astronomers, in utter disregard of this opinion, still continued to employ divergent series and to obtain from them a sufficient degree of approximation for practical purposes.

The impetus to a new mathematical treatment of the subject may be said to have come simultaneously from Stieltjes and Poincaré, although prior to this, in 1880, the legitimacy of the conclusion of Leibnitz had been established by Frobenius in a memoir which was suggestive of the beautiful theory developed later by Borel. According to the new view a divergent power-series is considered as having value in two distinct ways, either as enabling one to find an approximate value of some corresponding function (Poincaré and Stieltjes) or as a source of another algorithm which is convergent and therefore defines a proper function (Stieltjes, 1894).

The treatise of Borel begins with an interesting historical introduction. The body of the book can be divided roughly into four parts, which take up successively the four chief theories of divergent series; the asymptotic theory of Poincaré, the continued fraction theory of Stieltjes, the theory of Borel—characterized by the use of definite integrals containing a parameter z—, and, finally, the theory of Mittag-Leffler. The crowning achievement is without doubt Borel's own work, and his presentation of it is the most interesting feature of the book. No adequate idea, however, of the treatment of Stieltjes can be obtained without direct reference to the famous memoir of 1894, as Borel frankly states. This inadequacy of presentation is offset by the addition of an important supplement which Borel himself contributes to the theory of Stieltjes. We regret the omission of the method of Lindelöf. Its dismissal with a half dozen lines and without even a reference to his article in the *Acta Societatis Fennicae* is possibly due to a certain haste in preparation which we have fancied we have detected in several places. While the method of conformal representation (or transformation of the variable) which Lindelöf employs has been applied only to a restricted class of divergent series, it seems probable that it could be developed so as to give a more general theory.

On account of its somewhat abstract character Borel's treatise will probably be of greater interest to the pure mathematician than to the astronomer or student of applied mathematics. Few applications of the various theories have been given, probably because but few applications have yet been made, except in the case of the asymptotic theory of Poincaré. The author leaves us in some uncertainty as to how far his own theory has been carried and applied to differential equations. We hope that in a subsequent edition the important applications will be more fully developed.

We turn now to the little book of Hadamard. This is one of a series of short monographs published under the general title 'Scientia' and devoted to the 'Exposé et développement des questions scientifiques à l'ordre du jour.' The special topic taken up by Hadamard, as has already been stated, is the analytic continuation of a power-series, $a_0+a_1z+a_2z^2+\ldots$. In the consideration of this question two problems of the greatest importance and difficulty present themselves. These are: (1) The determination of the nature and position of the singular points of the analytic function defined by the series, and (2) the calculation of the value of the function at points exterior to the circle of convergence.

Hadamard has had the extremely difficult task of compressing into a few pages what has been done on these problems. In this he has succeeded admirably. It is extraordinary what an amount of information is packed away in the space of one hundred pages. Yet the work is no dry compilation of facts. Nowhere is the skill of the author more fully shown than in the manner in which he has woven his materials together. The theorems are analyzed, their significance is pointed out, and their demonstrations are outlined sufficiently to show the manner in which the subject is treated. Attention should also be called to the excellent bibliography with which the book opens and to which reference is constantly made. In correlating the one hundred and fifty memoirs here included Hadamard has performed a very important service. His admirable report is not suited to the reader who has little acquaintance with the general subject, but to the specialist and investigator it will be invaluable.

E. B. Van Vleck.

The Elementary Principles of Chemistry. By A. V. E. Young, Professor of Chemistry in Northwestern University. New York, D. Appleton & Company. 1901.

This book differs so radically from those in general use that if reviewed at all, it must be at some length. The author has used this method successfully for thirteen years; his object being to instruct the student during the first year by this method, which he calls the quantitative method. He says that its inception is due to Professor Josiah P. Cooke, of Harvard; he believes it 'both scientifically and pedagogically an improvement on prevailing methods.' The presentation of a topic in the text is to be studied by the student after performing the laboratory experiment illustrating the same.

The first 97 pages of the book are devoted to the physical and chemical properties of substances and to simple theoretic chemistry, including the fundamental quantitative laws of chemical action, the gas laws, atomic and molecular theory, kinetic theory of gases, structure and stereoisomerism. The author lays particular stress on the quantitative laws, and also on the laws of Gay Lussac, Dulong and Petit, Mitscherlich and Raoult, as illustrating the relation between equivalent weights and certain specific properties. The remainder of the book (147 pages) is 'On the relation between the properties of the elements in general and their combining weights; description of the first twenty-five elements and some of their compounds.' These elements are those comprised in the first three horizontal series of Mendeléeff's chart of the periodic system. The properties of the commoner elements of this selection and their compounds are described in considerable detail. Here the book proper ends. A second part (106 pages) gives the experimental illustrations and instruction in details of laboratory work. The book is illustrated by full-page portraits of many of the chemists and physicists mentioned.

This is indeed a different treatment from that commonly followed. A course in chemistry in which copper, mercury, silver and lead are ignored, while beryllium and cobalt find consideration is not common. Yet this does not prove that it is wrong. The author lays chief stress on general laws. The student's comprehension of a law is based on a roughly quantitative experiment illustrating it which he performs before studying the law. The experiments merit attention; they are well devised and easy to perform. The author illustrates these laws further by the behavior of a number of elements, including important metals, and most of the important acid-forming elements.

It is not the object of a college course in science to form specialists, and the question may be fairly asked whether the mental discipline and the capacity to pursue the study of chemistry afforded by this method are not of equal value, or (as the author believes) of greater value than can be obtained by the prevailing method. To those who agree with the author this book should be welcome.

The book has one grave defect, in omitting all mention of electrolytic dissociation. The author anticipates criticism in a passage on page eight of a pamphlet called 'Suggestions to Teachers' which accompanies the book; he says: 'Some perhaps would wish to include osmotic pressure and the electrical phenomena of conductivity, etc., together with the theory of ionization, but I have judged it impracticable to illustrate these phenomena experimentally without displacing other matter or going beyond the reasonable scope of one year's work.' To this the obvious answer is, that with our present knowledge it would be better to displace other matter, if need be, than to omit anything so fundamental and so easy of illustration as electrolytic dissociation, from a book called 'Elementary Principles of Chemistry.' With the hope that this gap may be filled in the next edition, the reviewer commends Professor Young's book to the attention of college and advanced high school teachers, who will find it suggestive.

E. RENOUF.

Studies in Evolution. By CHARLES EMERSON BEECHER. New York, Charles Scribner's Sons. 1901.

This is a notable volume. It is one of the series of the Bicentennial Publications of Yale University, and consists mainly of reprints of occasional papers selected from previous publications of the Laboratory of Invertebrate Paleontology, Peabody Museum. The most important are those on the structure and development of trilobites, and the 'Studies in the Development of the Brachiopoda.'

The aim of the first essay, 'On the Origin and Significance of Spines,' is an attempt, in the terms of ontogeny, phylogeny and chronology, to apply the general law of evolution to the spines of plants and animals. The discussion is a very interesting one, and we think Dr. Beecher satisfactorily shows from a great number of cases discovered by numerous observers that spines are a characteristic of the old age, both of the individual and of the type. In old age the organism, during the senescence of the type, 'blossoms out with a galaxy of spines, and with further decadence produces extravagant vagaries of spines, but in extreme senility comes the second childhood, with its simple growth and the last feeble infantile exhibit of vital power.'

We are inclined to think that the author is a little too hospitable to Wallace's notion that spines on desert plants may originate from the attacks of snails and browsing cattle. Our observations in the North African area, from Morocco to Egypt, on the edge of the Sahara in southern Algeria, and in Palestine, lead us to fully endorse the view of the Rev. Dr. Henslow, that in desert areas where plants are especially spiny or thorny, there are few snails, and a general absence of cattle. Over a century ago Pallas, and afterwards L. Regnier, in a paper published in 1792 (II., p. 101) in the very rare *Journal d'Histoire Naturelle,* edited by Lamarck and others, attributed the spiny growth of desert plants to the dryness of the soil. His observations appear to have been entirely overlooked by modern writers. A second article (p. 354), written by De Ramatuelle, is thoroughgoing in its evolutional tone, barring perhaps the speculations as to the origin of the spines from 'germes particuliers.'

Professor Beecher's splendid discovery of the nature of the appendages of trilobites and of other important points in their anatomy has entitled him to the lasting gratitude both of paleontologists and zoologists. This reprint of his original papers and illustrations is very opportune. It is possible, however, that the last word has not been said as to the nature of the larval trilobites or as to the position of the trilobites in nature. How the protaspis stage of trilobites can be likened to the nauplius of crustacea, and why trilobites should be placed among crustacea, we do not understand. That the presence of antennæ necessarily obliges us to regard trilobites as crustacea, when all the succeeding appendages of the body are of the same general type, not being differentiated into specialized mandibles, maxillæ, maxillipedes, thoracic and abdominal legs, as they are in Crustacea, including the Phyllopoda (though in them the appendages of the trunk are alike), does not seem logical. We would prefer to regard the trilobites, merostomes and Arachnida as members of a phylum quite distinct from that of the Crustacea. Is it not probable that the rather artificial phylum of Arthropoda will eventually have to be divided into three phyla? The resemblances in trilobites to Crustacea seem to us to be a case of convergence. The papers on Brachiopoda are likewise of great interest and value, and are crowded with valuable suggestions. The line of thought is largely based on the work of the late Dr. A. Hyatt, whose philosophical and scholarly methods have had such a happy and fruitful influence on the new generation of paleontologists.

A. S. Packard.

SOCIETIES AND ACADEMIES.

THE AMERICAN PHILOSOPHICAL SOCIETY.

The scientific program of the general meeting to be held next week is as follows:

Thursday, April 3, 10:00 o'clock.

'The President's Address': Gen. Isaac J. Wistar.

'Origin of the Oligocene and Miocene Deposits of the Great Plains': Professor John B. Hatcher, of Pittsburg.

'The Upper Cretaceous and Lower Tertiary Section of Central Montana': Mr. Earl Douglass, of Princeton.

'Evolution and Distribution of the Proboscidea in America': Professor Henry F. Osborn, of New York.

'On South American Mammals': Professor William B. Scott, of Princeton.

'The Mammals of Pennsylvania and New Jersey': Mr. Samuel N. Rhoads, of Audubon, N. J.

'The Identity of the Whalebone Whales of the Western North Atlantic': Dr. Frederick W. True, of Washington.

Afternoon Session, 2:00 o'clock.

'On the Molluscan Fauna of the Patagonian Formation': Dr. H. von Ihering, of São Paulo, Brazil.

'A Comparison Between the Ancient and Recent Molluscan Fauna of New England': Professor Edward S. Morse, of Salem, Mass.

'Distribution of Fresh Water Decapods and its bearing upon Ancient Geography': Arnold E. Ortmann, Ph.D., of Princeton.

'Systematic Geography': Professor William Morris Davis, of Cambridge, Mass.

'On Drift Casks in the Arctic Ocean': Mr. Henry G. Bryant, of Philadelphia.

'The Isthmian Canals': Professor Lewis M. Haupt, of Philadelphia.

8:00 o'clock at the Free Museum of Science and Art.

'The Relation of the American University to Science': President HENRY S. PRITCHETT, of Boston.

'The Advancement of Knowledge by the Aid of the Carnegie Institution': President DANIEL C. GILMAN, of Baltimore.

Friday, April 4, 10:00 o'clock.

'Historical Investigation of the Supposed Changes in the Color of Sirius since the Epoch of the Greeks and Romans': T. J. J. SEE, Ph.D., of Washington.

'Recent Progress in the Lunar Theory': Professor ERNEST W. BROWN, F.R.S., of Haverford, Pa.

'On a New Method of Transiting Stars': Professor MONROE B. SNYDER, of Philadelphia.

'On the Evolution of Martian Topography': Mr. PERCIVAL LOWELL, of Flagstaff, Arizona.

'Results of Observation with the Zenith Telescope at the Sayre Observatory': Professor CHARLES L. DOOLITTLE, of Philadelphia.

'On the Spectra of Gases at High Temperature': Professor JOHN TROWBRIDGE, of Cambridge, Mass.

'On Some Equations pertaining to the Propagation of Heat in an Infinite Medium': Professor A. STANLEY MACKENZIE, of Bryn Mawr, Pa.

Afternoon Session, 2:00 o'clock.

'The Direction of Evolution in Color-Marks in Rock Pigeons': Professor CHARLES O. WHITMAN, of Chicago.

'On Biological Heredity and Organic Evolution': Professor GIUSEPPE SERGI, of Rome, Italy.

'Is Scientific Naturalism Fatalism?' A one-minute paper: Professor WILLIAM KEITH BROOKS, of Baltimore.

'On *Dichotoma*, a new genus of Hydroid Jelly-Fish': Professor WILLIAM KEITH BROOKS, of Baltimore.

'On the Continuity of Protoplasm': Professor HENRY KRAEMER, of Philadelphia.

'Further Experiments on the Physiological Action of Ions': Dr. JACQUES LOEB, of Chicago.

'The Embryology of a Brachiopod': Professor EDWIN GRANT CONKLIN, of Philadelphia.

'Relationship of the Gordiacea': Professor THOMAS H. MONTGOMERY, JR., of Philadelphia.

'The Spermatogenesis of *Oniscus Asellus* Linn., with especial reference to the history of the Chromatin': M. LOUISE NICHOLS, Ph.D., of Philadelphia.

Saturday, April 5, 10:00 o'clock.

'The International Catalogue of Scientific Literature': CYRUS ADLER, Ph.D., of Washington.

'A Classification of Economics': Professor LINDLEY MILLER KEASBEY, of Bryn Mawr, Pa.

'Experiments on Cytolysis': Professor SIMON FLEXNER, of Philadelphia.

'On Osteitis Deformans': Professor JAMES C. WILSON, of Philadelphia.

'The Influence of Acute Alcoholic Intoxication upon Certain Factors involved in the Phenomena of Hæmotolysis and Bacteriolysis': Professor A. C. ABBOTT, of Philadelphia.

'Blindness from Congenital Malformation of the Skull': CHARLES A. OLIVER, M.D., of Philadelphia.

'Race Elements in American Civilization' (illustrated by German Examples): Professor M. D. LEARNED, of Philadelphia.

THE AMERICAN ELECTRO-CHEMICAL SOCIETY.

ARRANGEMENTS for the first general meeting of the American Electro-chemical Society, to be held at Philadelphia on April 3, 4 and 5, are as follows:

Thursday afternoon, April 3, 2 P.M. Visits to places of interest.

Thursday evening, April 3, 8 P.M., at the Manufacturer's Club, inaugural meeting. This meeting will be devoted to the organization of the Society, adoption of a constitution and by-laws, election of officers, determining times and places of future meetings, discussing the question of publishing the transactions, etc.

Friday morning, April 4, 9 A.M., at the lecture hall of the John Harrison Laboratory of Chemistry of the University of Pennsylvania. Reading and discussion of the following papers:

'A University Course in Electro-chemistry': Professor JOSEPH W. RICHARDS, Ph.D., Lehigh University, Bethlehem, Pa.

'Electrodes': CLARENCE L. COLLINS, 2d, Niagara Falls, N. Y.

'Note on the Gladstone Tribe Couple': Professor WILDER D. BANCROFT, Ph.D., Cornell University, Ithaca, N. Y.

'The Nascent State': C. J. REED, Philadelphia, Pa.

'The Electrolytic Reduction of Lead': PEDRO G. SALOM, Ph.D., Philadelphia, Pa.

'Electrodeless Conduction in Electrolytes': Carl Hering, Philadelphia, Pa.

'On the Electrolysis of Sodium Nitrate and the Composition of the Developed Gases': C. W. Volney, Ph.D., Keyport, N. J.

Professor Chas. A. Doremus, M.D., Ph.D., Subject to be announced.

Friday afternoon, April 4, 2 p.m., at the John Harrison Laboratory.

'Current Electro-chemical Theories': Professor Louis Kahlenberg, Ph.D., University of Wisconsin, Madison, Wis.

'A Zinc-Bromine Storage Battery': Herbert H. Dow, Midland, Mich.

'Continuous Electrolysis of Solutions of Metals': N. S. Keith, Ph.D., New York City.

'A Method of Electrolytic Production of Zinc from its Ores': Samuel S. Sadtler, Philadelphia, Pa.

'The Electrolytic Rectifier': Professor C. F. Burgess, University of Wisconsin, and Carl Hambuechen, Madison, Wis.

'On the Relative Speed of the Ions in Solutions of Silver Nitrate in Pyridine and Aceto-nitrile': Herman Schlundt, Ph.D., Madison, Wis.

'Fall of Potential in Electrolytes': Carl Hering, Philadelphia, Pa.

'Caustic Alkalies and Chlorine by the Dry Electrolytic Process': Chas. E. Acker, Niagara Falls, N. Y.

Friday evening, April 4, after 8 p.m., at the Manufacturer's Club, 1409 Walnut Street. Informal reception.

Saturday morning, April 5, 9 a.m., at the John Harrison Laboratory. Reading and discussion of the following papers:

'On a New Type of Electrolytic Meter': Konrad Norden, Ph.D., New York City.

'The Reversible Copper Oxide Plate': Woolsey McA. Johnson, Hartford, Conn.

'A Thermodynamical Note on the Theory of the Edison Battery': E. F. Roeber, Ph.D., Philadelphia, Pa.

'Electrolysis of an Aqueous Solution by Alternating Current': Professor Jos. W. Richards, Ph.D., Lehigh University, Bethlehem, Pa.

'The Atom of Electro-chemistry': Arvid Reuterdahl, Providence, R. I.

Saturday afternoon will be devoted to visits to places of interest.

THE GEOLOGICAL SOCIETY OF WASHINGTON.

At the meeting of the Society on February 26, the first paper, by Mr. T. W. Vaughan, was entitled 'Earliest Tertiary Coral Reefs in the Antilles and United States.' Mr. Vaughan made a few remarks in order to indicate when, during Tertiary time, the physical conditions in the regions mentioned in the title of his communication first became suitable for the formation of coral reefs. A few species of reef-building genera occur in the Midway (basal Eocene) beds of Alabama, and taken as a whole the Eocene corals of the United States characterize only moderately deep or shallow water; but strictly speaking, no Eocene coral reefs are known in the United States. Reef-building genera occur in the Vicksburgian (Lower) Oligocene at Vicksburg, Mississippi. The temperature of the water was at least subtropical and the depth was not great, probably not too great for the formation of reefs; but some other condition, probably such as muddiness of water, prevented their formation. The Coral limestone at Salt Mountain, Alabama, is a coral reef limestone, but its precise stratigraphic position has not been determined. It is either uppermost Lower Oligocene or basal Upper Oligocene. The Upper Oligocene in the United States was initiated by an extensive development of coral reefs. They occur in southwestern Georgia along the Flint River, the Tampa silex beds of Tampa, Florida, and at numerous other localities in Florida. The fauna is rich in genera, species and individuals. Reefs of the same age are very abundant in the Antilles. They occur in Cuba in the vicinity of Havana, Matanzas, Santiago and other places. They probably are present in the island of Haiti. Other islands in which Upper Oligocene rocks exist are Porto Rico, Antigua and Arube (Dutch West Indies).

There are no Miocene coral reefs in the United States, the temperature of the water being too cold. The species of corals known grew in water only a few fathoms in depth. It is not at present known whether or not Miocene reefs existed in the West Indies. Apparently during Miocene time the Antilles stood much higher than at present; therefore if any did exist they would at present be submerged.

Pliocene reefs were extensively developed along the Florida coast, for instance, along the Caloosahatchee River. The genera of the Pliocene corals are the same as those at present living in the Floridian and Antillean seas, but often there are appreciable specific differences between the Pliocene and recent representatives of the same genus.

Mr. Bailey Willis spoke on the 'Conditions of Overthrust in the Northern Rockies.' After restating the facts relating to the overthrust of Algonkian strata upon Cretaceous with a displacement of more than seven miles, along the eastern flank of the northern Rocky Mountains in northwestern Montana, Mr. Willis presented a hypothesis of origin and development of this structure. It is assumed that in Cretaceous time Algonkian strata in this region were essentially flat, and in consequence of subsidence were buried under Dakota and Pierre sediments, with a shore line not far from the position of the present mountain range. Algonkian strata beneath the marine area being depressed and beneath the land area being raised, they were bent parallel to the general trend of the shore. When later the strata were compressed, the initial bend determined an anticline in this same position. Erosion of the arch cut deeply into Algonkian beds and left the edges exposed and free to move. Continued compression resulted in their being thrust upward and northeastward upon the eroded surface, until Algonkian limestones came to rest upon Cretaceous areas. The structure closely resembles the Rome fault, Georgia. The date of development is inferred to have been early Tertiary.

Mr. F. E. Matthes presented a paper on 'Glacial Erosion in the Northern Rockies.' The range was shown to have been deeply dissected before the advent of the glaciers. The valleys were nearing maturity and had low gradients; the glaciers which subsequently occupied them had therefore but little fall from their sources to their distal ends. They moved slowly and were of considerable thickness. The lengths of the various trunk glaciers were small in proportion to the large névé areas which they drained.

The frequent occurrence of many valleys radiating from one point was shown on the map. The effect of this arrangement upon the valley glaciers was shown to have been a general retardation of their flow and a consequent increase in thickness above their junction. Some attained a thickness of over 3,000 feet in some parts of their course.

The radiating system of ravines at the heads of valleys was shown to be particularly favorable to the development of cirques. At least two sets of cirques at different elevations are found in these mountains, indicating oscillations of the névé line to as low as 6,000 feet altitude.

The definitions of the snow line as given in three text-books now in use were compared and found to be greatly at variance with each other. A new definition was favored in which the topographic element is given due weight, and which makes the snow line virtually coincident with the névé line as found on glaciers.

The tendency of glaciers to flatten the grades of their channels, beginning at the upper ends, was shown to be productive of the step-like profiles of glaciated valleys. The cause of this tendency was sought in certain motions in the interior of the glaciers, the explanation of which was not attempted.

The widening of the valleys by cliff recession was emphasized as an important factor in producing discordance between valleys. Discordance was shown to be produced by (1) deepening of main valley, (2) widening of main valley; and to be diminished by (3) deepening of side valley. Cases were pointed out on the contour maps of valleys meeting with discordances ranging between 300 and 1,500 feet; also of several meeting with perfect accordance. Nor were the discordances always in inverse ratio to the drainage areas of the respective valleys.

The conclusion was reached that in no case could the discordance of a side valley be taken as a measure of the deepening of the main valley.

ALFRED H. BROOKS,
Secretary.

NEW YORK ACADEMY OF SCIENCES.

PUBLIC LECTURE.

On February 26 a public lecture was presented under the auspices of the Section of Biology, by Professor Bashford Dean, of Columbia University, entitled 'Journeyings of a Naturalist through Japan and the Philippines.'

Professor Dean referred to the zoological relations of the Japanese archipelago with the adjacent continent on the one hand, and with the island series on the other—*i. e.*, (1) the Aleutian, (2) through the Bonin Islands with the region of New Guinea, and (3) through the Liu Chiu Islands with Formosa and the Philippines. The importance of the line of Blakiston separating the Hokkaido from the southern islands was emphasized.

Especial attention was called to the favorable facilities for zoological work which are offered in the region of Misaki, near the mouth of the Bay of Tokyo, and to the work of the Marine Laboratory of the Imperial University in this region. Dr. Dean had an opportunity of examining the centers of animal artificialization, an art in which the Japanese have been so eminently successful. Especially praiseworthy is the method of oyster-culture practiced in the Inland Sea near Hiroshima; hardly less interesting were the establishments in which varieties of gold fish are propagated; and even more striking were those for the cultivation of the breed of Tosa fowls, in favorable specimens of which the tail feathers attain the great length of fifteen feet. Success in the maintenance of this breed appears to be due to the selection of those fowls in which moulting occurs irregularly, and the effort is made to entirely suppress the moult in that region of the fowl where long feathers are to be produced. In referring to a journey in the Philippines, Professor Dean described many interesting experiences, particularly those at Maujuyod, where living specimens of *Nautilus* were obtained.

Henry E. Crampton,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

At the meeting of the Academy of Science of St. Louis on the evening of February 17, Dr. Gellert Alleman, of Washington University, delivered an address on 'The Chemical Constitution and the Manufacture of Portland Cements.' The growth of the cement industry was treated, the various steps of development being shown by lantern slides illustrating past and present types of machinery employed in its manufacture. Several slides were shown giving tabulated results of a number of analyses of different commercial Portland cements.

Mr. Charles Espenschied read a letter from Mr. Seymour Carter, of Hastings, Minnesota, in which was described a method of Professor Anderson, of Columbia University, by which it was stated that cereals could be directly transformed to food-stuffs. The process consists of enclosing the cereal to be treated in a hermetically sealed vessel and subjecting it to a temperature of about 450° F. for a certain time, and immediately thereafter opening the vessel, when it is found that the grains expand to six or eight times their normal size. The inventor states that the process does not alter the composition of the cereal. Samples of several cereals treated in this manner were shown.

Two persons were elected to active membership.

William Trelease,
Recording Secretary.

THE TORREY BOTANICAL CLUB.

At the meeting of the Club on January 29, the first paper was by Dr. Britton, entitled, 'Notes on the Crassulaceæ,' and is to appear in print, being a part of a contribution toward the projected 'Systematic Botany of North America.' Remarks followed by Dr. C. C. Curtis, Dr. Rydberg, Dr. Small, Dr. MacDougal and Mrs. Britton. The distribution of the Crassulaceæ was commented on, Dr. Britton speaking of the isolated colonies of high mountain species, which seem to have been continuously highly interbred, so producing highly specialized species.

The second paper, by Mr. F. S. Earle, entitled, 'New Genera of Fungi,' founded on representatives from California and New Mexico, will soon appear in the Garden *Bulletin*.

Dr. Earle also exhibited a rosebush from under glass at the Garden, the roots of which have been attacked by a fungus now under examination and cultures of which were exhibited. The mycelium was abundant in the fibrous roots; also in the bark and cambium immediately above ground, and had caused sudden yellowing and dropping of the leaves.

Dr. MacDougal recalled the suggestion that potatoes are the result of fungal infection of the underground stem; it is said that no one has ever examined a potato tuber without finding fungus traces in it. In many cases of precocious blooming among both wild and cultivated plants, the cause is stimulus from similar infection.

Dr. MacDougal also exhibited specimens of two remarkable Alpine xerophytes from an altitude of 4,000 feet on New Zealand mountains, known as vegetable-sheep, *Raoulia* and *Haastia*, composites between which belongs *Gnaphalium* in order of affinity.

Dr. Rydberg spoke of a Rocky Mountain phlox with similar growth in cushion-like masses.

Mrs. Britton reported on the progress of her studies of a *Vittaria* collection made by Dr. Britton at St. Kitts, and exhibited drawings, and the present indication that two different specific names have been in use for different stages of the same life-history.

EDWARD S. BURGESS,
Secretary.

THE NORTHEASTERN SECTION OF THE AMERICAN CHEMICAL SOCIETY.

THE regular monthly meeting of the Section was held on February 27 in the physics lecture room of the Massachusetts Institute of Technology, Professor L. P. Kinnicutt presiding. Professor Henry P. Talbot addressed the Society on 'The Recorded History of the Members of the Argon Group.' The general history, the methods of isolation and identification of these gases, together with their physical properties, and their position in the periodic system were all carefully reviewed up to the present time.

HENRY FAY,
Secretary.

THE ONONDAGA ACADEMY OF SCIENCE.

THE Academy met in the historical rooms in Syracuse on Friday, Feb. 21, 1902. Dr. W. M. Beauchamp gave the presidential address on the 'Peopling of Early America.' He gave a résumé of the early investigations, touching briefly on the different theories proposed, and emphasizing the fact that the answer to the problem lies in the researches into the languages, customs and manners of the present nations and the archeological remains. Dr. Beauchamp gave many interesting items from his extended observations on the native tribes of New York State.

T. C. HOPKINS,
Corresponding Secretary.

DISCUSSION AND CORRESPONDENCE.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE: ANTHROPOLOGY.

THE fifty-first meeting of the American Association for the Advancement of Science will be held at Pittsburgh, Pa., on June 28 and July 3, 1902. Mr. Stewart Culin, of the University of Pennsylvania, will preside over the Section of Anthropology.

Anthropologists are cordially invited to attend and contribute papers upon subjects connected with their fields of research. Several members of the Section have informally expressed the desire that some special effort should be made by the museum and field workers of the Section to present papers on the collections of importance with which they are familiar.

In order that a preliminary sectional program may be distributed in advance of the meeting, titles of communications should be sent to the secretary as soon as possible. Abstracts of papers, or the papers themselves, may be sent later at the convenience of the authors, who are reminded that no title will appear in the final program until the paper, either in full or in abstract, has been passed upon by the sectional committee.

HARLAN I. SMITH,
Secretary of Section H, Anthropology.

AMERICAN MUSEUM OF NATURAL HISTORY, NEW YORK.

FELIS OREGONENSIS RAF. AGAIN!

In his recent 'Revision of the Pumas' (*Proc. Wash. Acad. Sci.*, pp. 577–600), Dr. C. Hart Merriam devotes over a page to the inapplicability of the above name and to censuring my action in bringing it forward to replace *F. hippolestes olympus* given by himself in 1897. He states that it is a 'fallacious interpretation of our principles of nomenclature' to replace a name well characterized and accompanied by definite type and locality, by an older one deficient in these respects. This statement will, I think, be questioned by many zoologists who have erred in this way more than I.

Personally, I would be only too glad to throw out of consideration all the names proposed by Rafinesque and others of his time, as it would save us a deal of trouble, but if we recognize the principles of priority I see no excuse for such action, and such questions as the present one resolve themselves entirely into a consideration of the applicability of the older name.

This is largely a matter of individual opinion and in the absence of any tribunal for the consideration of a uniform nomenclature for our mammals individual preference will prevail. However a few words regarding Dr. Merriam's stand may not be out of place.

In Rafinesque's first paper he undoubtedly has in mind the *Felis concolor* group, that will be admitted on all hands.

In his second paper he names a variety of the puma (as mentioned in the first paper) from northwestern United States (Oregon by implication). The absence of a definite type locality in no way invalidates the name if otherwise satisfactorily diagnosed. We have many names now in use with just as vague type localities.

The description is very brief, but as good as many other early diagnoses and to my mind clearly indicates the same animal later characterized by Dr. Merriam. Moreover, I do not think it is 'grossly incorrect.'

Rafinesque says 'Dark brown, nearly black on the back, belly white.'

Dr. Merriam says 'Dark rufous brown, darkest along middle of back, backs of ears black, tip of tail blackish, breast and inguinal region soiled whitish, anterior part of throat white.'

Rafinesque had no 'manual of colors' and was of course not as exact as our present-day systematists, but it seems to me that his description is sufficiently accurate.

As to Dr. Merriam's argument that he probably never saw a specimen of the animal, we have positively no evidence one way or the other, and the fact does not affect the validity of the name nor do Dr. Merriam's further remarks about the other unrecognized cats that Rafinesque speaks of. The descriptions of *Cervus macrourus* and *C. hemionus* of the same author which are recognized and adopted by Dr. Merriam are associated with a lot of unidentifiable descriptions, and are admittedly based upon descriptions of travelers, while the diagnoses are no better than that of *Felis oregonensis*. If one stands, so should the others, in my estimation.

I might add that, so far as I am aware, every one who has written on this puma since my note appeared in Science has followed my views, even Dr. Merriam himself, who adopted the name *oregonensis* without comment, in his 'Biological Survey of Mt. Shasta' (p. 104).

As to the statement that no name based on hearsay accounts of travelers would be accepted if published to-day, we might suggest some recent cases that come pretty near to this, such as *Equus johnsoni*, which was based upon hearsay accounts of native Africans and two strips of skin, and *Macrias amissus* (Science, December 13), on a photograph and regretful recollections of a fish that was lost overboard after having been captured!

Witmer Stone.
Academy of Natural Sciences,
Philadelphia, Pa.

A VERY SENSITIVE THERMOSTAT.

For many forms of scientific investigation constancy of temperature is required. Such constancy may be secured, within a few hundredths of a degree, by several types of thermostat. For certain inquiries undertaken by the writer relative to the so-called 'critical' phenomena of liquids and gases, a much greater degree of accuracy was necessary.

To meet this demand, a thermostat was devised, of which a description will shortly appear in the *Journal of Physical Chemistry*. The regulator of this instrument functionates so perfectly that the temperature can be kept continuously at the same thousandth of a degree for hours at a time. It is so constructed moreover as to be capable of adjustment, within one or two hundredths of a degree, to any desired temperature over a range of about fifty degrees.

The most important factors which make such fineness of regulation possible are the following:

1. An extremely efficient circulation in the bath, which eliminates all local differences of temperature large enough to be readable.

2. Such a construction of the regulator that the expansive medium feels each minutest change of temperature and reacts promptly to it.

3. Provision for supplying the bath at all times with just the amount of heat needed, and no more. The regulation does not consist in alternately admitting and shutting off the inflow of heat, but in a 'throttling' of the same.

The extreme accuracy of function mentioned above is naturally obtained only when the thermostat is shielded from sudden changes of radiation. But excellent results are possible without such protection. Without the use of any insulation whatever, the bath can be held at a temperature of thirty or forty degrees within a hundredth of a degree.

W. P. Bradley.

Wesleyan University.

SCIENTIFIC NOMENCLATURE.

To the Editor of Science: In Science for March 21, I find an article on 'Scientific Nomenclature,' by Mr. Frank W. Very, which concludes with the following words:

> Scientific descriptions remain unintelligible to the lazy man who hates to use the dictionary. They are free property to all who are willing to take this trouble.

On other pages of Science for March 21 (pp. 458 and 459), I find the words 'ecology' and 'ecological.' As I had never seen them before, I said to myself: 'Here is my chance to vindicate Mr. Very's judicious hint about the lazy man and the dictionary.' So I turned to the Century dictionary, but did not find ecology or ecological. I next had recourse to the new English dictionary of Murray, without success, and then to the new edition of Webster, published the present year. None of these contain the words above mentioned. Recourse to Liddell & Scott's Greek lexicon was equally unavailing. I am moved, therefore, to ask you for an explanation of this new term.

Horace White.

New York,
March 22, 1902.

[Ecology has doubtless been coined from the same word as economics, being the branch of zoology or botany that is concerned with the dwelling place or distribution of animals or plants. It will probably come as a shock to biologists to learn that this word is not to be found in recent dictionaries, as it is used in elementary books and courses. The word appears to be post-Darwinian; perhaps some reader can tell us when and where it was first used.—Editor.]

BOTANICAL NOTES.

A POPULAR BOOK ON TREES.

Whatever tends to popularize a knowledge of our trees is to be commended. Any book which induces a considerable number of people to give more attention to the structure and habits of trees deserves our hearty approval. It is true that too often these popular books are so full of blunders that the scientific man is constantly irritated as he runs over the pages, and as a consequence he is too often unable to see the great body of valuable matter hidden beneath the superficial errors. We have had within the last year or two a number of useful books dealing with plants of various kinds from mushrooms and ferns to wild flowering herbs, shrubs and trees. Now, another book is brought out by Knight and Millet, of Boston, under the title of 'Studies of Trees in Winter,' by Annie Oakes Huntington, with an introduction by Professor Sargent. The fact that so eminent a botanist has thought it worth his while to write an introduction to the book at once bespeaks our good opinion. A glance at the pages is sufficient to show that in this we are not mistaken. There is, first, a short chapter giving such information as is necessary in the study of the tree in winter, followed by fourteen chapters on groups of trees, as 'The Horse-chestnut' (including also the Ohio buckeye), 'The Maples' (including seven species), 'The Ashes' (four species), 'The Walnuts and Hickories' (six species), etc. The illustrations are exquisite, consisting of 'half-tone' reproductions of characteristic photographs. The colored plates are especially fine, that of a cross-section of an oak trunk being really so perfect that one must run his hand over the plate to convince himself that it is not an actual section of the wood. While the book is printed and bound in a style quite too elegant for a text-book for schools, the subject matter is well adapted for such usage. A less expensive edition for schools should be brought out by the publishers, and in such form it should have wide use in the public schools.

GATTINGER'S FLORA OF TENNESSEE.

It speaks well for a state when its legislature authorizes the publication of a book on technical botany. This was done a little less than a year ago by the legislature of Tennessee in 'an act for the acceptance by the state of a work on botany prepared by Dr. A. Gattinger, and to make an appropriation for its publication and distribution.' The result is before us in the form of a neatly printed book of nearly three hundred pages. That the pages are marred by too many typographical slips is not the fault of the generous-minded men who made provision for its publication, nor of the venerable author, but of the inexperienced printer, to whom much of what he put into type must have been quite unintelligible. The book opens with about twenty pages of prefatory matter, in part historical; the remainder is devoted to a discussion of regional distribution of plants, and this is followed by about 160 pages devoted to an annotated list of the Pteridophyta and Spermatophyta of the state. Following this are about a hundred pages, entitled, the 'Philosophy of Botany,' including several papers of very unequal value. In the list of plants the modern system, as well as the modern nomenclature, is used, the latter being none other than that of the so-called 'Rochester Rules,' which he says he 'reluctantly adopted' after careful deliberation. This useful list is, therefore, another contribution to the more general use of the names recommended by the 'Rochester School' of systematic botanists, and is a sign of no small significance of the inevitable trend of botanical opinion and practice in this country.

The species noted are 2,218, of which 224 are Compositæ; 81, Labiatæ; 52, Umbelliferæ; 172, Malvaceæ; 251, Euphorbiaceæ; 103, Papilionaceæ; 83, Rosaceæ; 57, Cruciferæ; 61, Moraceæ; 124, Cyperaceæ; 223, Gramineæ; 15, Coniferæ; 61, Pteridophyta.

ENGLER'S PFLANZENREICH.

Heften 7 and 8 of this work have appeared within the past few weeks. Number 7 is devoted to the little group of water plants known as the Naiads (Naiadaceæ), and is from the hand of A. B. Rendle, of the British Museum. We have in this number a promise of what we may look for in the future, since this one has the general discussion in English, instead of in German, as has been the rule heretofore. It is quite novel to have a 'part' of a book in which three languages are used, the technical parts being in Latin, as usual, while some of the notes under the species are in German. In this paper the author restricts the family to the genus *Naias*, in which he recognizes thirty-two species. Number 8 takes up the maples (Aceraceæ), and the work is done by Dr. Ferdinand Pax, of the University of Breslau. Two genera are recognized, *Dipteronia*, a monotypic Chinese genus, and *Acer*, the maples proper. The latter genus is divided into thirteen sections, and all told, 113 species are described. In accordance with the latest conceptions of generic lines the box-elders (*Negundo*) are included in *Acer*. It is interesting to note that Dr. Pax has adopted *A. saccharnum* L. as the name of the silver maple (instead of *A. dasycarpum* Ehrh.) and *A. sac-*

charum Marshall for the sugar maple (not *A. saccharinum* Wang). In both numbers the illustrations are of the high order of the preceding *Heften*.

CHARLES E. BESSEY.
THE UNIVERSITY OF NEBRASKA.

NOTES ON INORGANIC CHEMISTRY.

THE first two numbers of the *Zeitschrift für Electrochemie* for January contain an experimental investigation by F. Haber and R. Geipert on the preparation of aluminum. The authors used as a crucible a block of coal 245×245×175 mm., the opening having a diameter of 113 mm. at the bottom, 138 mm. at the top, and 70 mm. deep. This crucible served as a kathode, and a rod of coal 66 mm. in diameter as anode. The bath consisted of an artificial cryolite containing somewhat less than the theoretical amount of sodium fluorid, and in this pure alumina was dissolved. The most favorable current was 3 ampères per square centimeter at 7 to 10 volts. Under these conditions the electrolysis proceeded as smoothly and regularly as in the ordinary electro-analytical precipitation of a metal. Although the density of the solid bath is slightly greater than that of aluminum, when fused it is slightly lower. If, however, too much alumina is dissolved in the bath, it becomes too dense and the aluminum, instead of sinking, floats, often short-circuiting the current. A higher percentage of aluminum fluorid than is present in natural cryolite is advantageous, as it renders the bath more fusible. The output varied from 50 to 55 per cent. of that theoretically required by the current. The aluminum prepared was of particularly pure quality, and in the opinion of the authors the production of the same quality on a large scale is possible by the use of pure materials and an anode low in ash. It was found necessary to add fluorid to the bath from time to time to replace that which is lost by a gradual volatilization.

The modern manufacture of tin foil is described by Rafael Granja in the *Journal* of the Society of Chemical Industry. Three varieties of tin foil are on the market: pure tin foil, composition foil, and Dutch leaf. The composition foil consists of lead, covered on both sides with a thin coating of tin, while the Dutch leaf is prepared from an alloy of tin with a few per cent. of a secret metallic composition. The grade of fineness of the foil is expressed by the number of square inches which a pound of the foil will cover. Thus the limit reached by the thinnest pure tin foil is 10,000, by composition foil 7,000, while Dutch leaf reaches 14,000 square inches. The manufacture of the foil, and also of the capsules for the tops of bottles, is fully described in the paper.

FROM the Physiological Laboratory of the Veterinary High School of Vienna comes a contribution, which indirectly contributes to our knowledge of the occurrence of iodin in soils, and especially with reference to the question as to whether it is largely confined to those soils which are near the sea. On examining the thyroid glands of sheep from different Hungarian localities, Wohlmuth finds that the percentage of iodothyrin—0.2–0.35 per cent.—is approximately the same as that found by Baumann in German and French sheep, and that the iodothyrin contains about the same amount of iodin—3.2–3.3 per cent.—as that obtained by Baumann. The sheep from these far-inland localities must therefore have found in their food the necessary quantity of iodin for a normal amount of normal iodothyrin.

THE work of Liversidge on the crystalline structure of metallic nuggets has already been noticed in these columns. This work has been continued by the examination of a number of new specimens. The structure is studied by etching a polished surface of the metal. In nuggets from Lake Superior containing both silver and copper, it appears that the silver has been deposited upon the copper. Gold nuggets from the Klondyke present a structure and appearance quite different from those of any other locality. They are very pale in color, owing to the large quantity of silver present. An assay of two specimens gave only sixty-five per cent. of gold. In the case of silver and copper nuggets, as has been found with those of gold and platinum, there is every indication that the metal has been deposited from solution, and there is nothing to indicate that the nuggets have undergone either igneous or hydrothermal fusion.

It is not often that there is an opportunity to determine the changes in a well water extending over a long period of years, but this has been done by W. W. Fisher in the case of the water of the Trafalgar Square well. He prints in a recent number of the *Analyst* an analysis just made of this water, comparing it with analyses made in 1848 and in 1857. These analyses show that the character of the water has not changed essentially, although the quantity of potassium salts has diminished quite decidedly. In this connection the author calls attention to the fact that alkaline waters are drawn not only from the chalk under the London clay, but also from other deep limestones, and draws the conclusion that the alkali salts present come from the chalk itself and not from percolation. In covered deposits where no natural drainage is possible, the chalk is found to contain soluble salts, distinct traces of sodium carbonate, chlorid and sulfate being found in chalk beneath London at a depth of 500 and 800 feet.

J. L. H.

RECENT ZOOPALEONTOLOGY.

FRITSCH'S 'FAUNA DER GASKOHLE UND DER KALKSTEINE DER PERMFORMATION, BÖMENS.'

Dr. Antoine Fritsch, of Prag, has recently issued a complete list of his publications extending back to the year 1851 and covering essentially the broad field of his zoological and paleontological observations. His most monumental work is on the primitive fishes, amphibians and reptiles of the Permian period described in a series of monographs under the title cited above, beginning in the year 1880.

The first monograph covers the long-bodied stegocephalian amphibians of the order Aistopoda; this was continued with the description of the short-bodied forms resembling the modern perennibranchiates in 1884. More advanced labyrinthodonts were described in 1885, the amphibian division of the fauna being concluded in 1887.

The second volume is mainly devoted to the lung fishes, or Dipnoi, and to the more primitive types of selachians. Most important of these types is the genus *Pleuracanthus* which bridges over the gap in fin-structure between the American genus *Cladoselache,* as described by Newberry and Dean, and the fin of the modern shark. This transition form completely disestablished the archipteryial theory of Gegenbaur and established the fin-fold theory of Thacher and Balfour. The other primitive selachians were concluded in 1893, and the great modern actinopterygian types corresponding to Agassiz's ganoids were covered in the parts which appeared during the succeeding two years.

The fourth volume, of which three parts have appeared between 1899 and the present time, is devoted to the insects of the Permian period, especially the myriopods and arachnoids. Finally, this monographic series is brought to a close in 1901 by the third part of the fourth volume which covers the crustaceans and molluscs. This series of monographs will constitute the greatest monument to its author. Also, those who visit Prag find there to their surprise that this Bohemian city contains one of the most beautiful zoological museums in the world, developed under the direction of this veteran zoologist.

H. F. O.

GRAVITY ON THE OCEAN.

The proceedings of the Academy of Sciences of Berlin of February 13, 1902, contain a paper by Professor F. R. Helmert on Dr. Hecker's determination of gravity on the Atlantic Ocean. In July and August, 1901, the International Geodetic Association entrusted Dr. Hecker, of the Potsdam Geodetic Institute, with the duty of making relative gravity observations on the Atlantic Ocean on a voyage between Hamburg and Bahia. The method employed was to determine the pressure of the atmosphere by means of a barometer and a hypsometer (boiling point thermometer). The barometric formula contains a term depending on the intensity of gravity at the place where the observation was made. The hypsometer is independent of this influence. The comparison of the results of the two methods affords a means of determining relative gravity with more or less accuracy. The results given are preliminary, but, according to Dr. Helmert, they are sufficient to indicate that gravity on the ocean where its depth is profound, between Lisbon and Bahia, is nearly normal. Dr. Helmert states that they furnish splendid confirmation of the hypothesis of Pratt in regard to the isostatic arrangement of the masses of the earth's crust. He states that taken in connection with the results of Nansen's pendulum observations on his North Polar Expedition this hypothesis, from now on, may be reckoned with as a fact at least in the sense of its being a general rule, and he believes that the radial anomalies of the geoid in comparison with the mean ellipsoid will probably not exceed the limits of $\pm$ 100 meters previously suggested by him.

O. H. T.

BRYAN DONKIN.

THE English journals announce the death of Mr. Bryan Donkin, a distinguished engineer and man of science to whom much credit is due for extensive and valuable work in the application of scientific methods in the development of the theory and the art of heat-engine design and construction. His research work has been extensive and continuous and his field of work, applied thermodynamics, mainly, afforded full play for all his energies.

Mr. Donkin was born in 1835, coming of a distinguished family of whom his father, John Bryan, his grandfather, Bryan Donkin, and the physician, Dr. Horatio Bryan Donkin, were famous members. He was educated at the University College of London and at the École Centrale des Arts et Métiers, in Paris, and later served an apprenticeship in the workshops of his uncle, at Bermondsey. He then went into business and was sent abroad to erect engines and the heavy machinery of paper-mills, and similar construction. He spent much time in Russia.

He was a partner in 1868 and the chairman of the corporation in 1889. About 1870, he became interested in the then rare opportunities of scientifically investigating the efficiencies of the heat-engines and presently made himself one of the leaders in promoting the modern scientific method in engineering and in researches relating to the subject. His influence in the promotion of the movement was exceedingly great and correspondingly useful. He was probably the first to make a complete balance-sheet exhibiting the receipts and expenditures of energy, in the operation of the steam-engine, in such manner as to reveal precisely the extent and the method of distribution of the stream of energy entering the system, its separation into the various currents flowing through the engine and its final disposition as useful and as wasted energy, and the resultant efficiency of the system.

He studied the effects of 'cylinder condensation' and of the two correctives of that serious form of wasted energy, superheating and steam-jacketing, and invented the 'revealer' to reveal the then mysterious changes occurring in the interior of the engine-cylinder. He established many important facts and laws of thermodynamic operations and thermal action, and was a very earnest advocate of all really sound movements in the direction of economic progress.

He wrote extensively on the subject which came to be his specialty and some of his papers are regarded as among the classics of that department of literature. He published a treatise on gas-engines which has now gone to a third edition and translated Diesel's 'Theory and Construction of the Rational Heat-Motor,' and, in 1898, issued a treatise on the steam-boiler. He was familiar with the French as with the German, and spent much time on the continent, studying the latest developments in his field, in all countries.

He was a vice-president of the British Institution of Mechanical Engineers, Watt medallist, Telford and Manby premium and prizeman of the Institution of Civil Engineers, a member of the Royal Institution and of a number of European associations and also of the American Society of Mechanical Engineers.

Mr. Donkin was famous for important and admirable professional work, both in construction and in research, was known in all countries as a great writer and student and scholar, and, among his friends and acquaintances, was recognized as a man of genius and of heart, of perfect frankness and integrity, as well as of delightful personality. He was very extensively acquainted, at home and abroad. His death will be regretted by his numerous acquaintances, and by every one familiar with his work, and will be mourned long and sincerely by all who had the good fortune to be numbered among his personal friends. R. H. T.

SCIENTIFIC NOTES AND NEWS.

By order of the president, the spring meeting of the Council of the American Association for the Advancement of Science will be held in the Cosmos Club, Washington, D. C., on Thursday, April 17, 1902, at 4:30 P.M.

Edinburgh University will confer its LL.D. on President J. G. Schurman, of Cornell University, and on Principal A. W. Rücker, of London University.

Dr. Julius Kuehn, professor of agriculture at the University at Halle and director of the Agricultural Institute, has been elected a corresponding member of the Paris Academy of Sciences.

The Russian Geographical Society has awarded its Constantin medal to the geologist, K. J. Bogdanowitsch; the Semenoff medal to Dr. Eduard Suess, professor of geology in the University of Vienna, and the Przewalsky medal to the zoologist, Professor Zarudnyi.

Professor C. R. Barnes, of the University of Chicago, sailed for Europe March 22, and will spend nine months in visiting the botanical centers.

Dr. D. T. MacDougal has returned from Arizona and Sonora with an extensive collection of giant cacti and other large xerophytic plants, which are being installed in the horticultural houses of the New York Botanical Garden. Dr. MacDougal characterizes the recent sensational announcement in the daily press concerning the extermination of the tree cactus (*Cereus giganteus*) as being utterly without foundation.

Professor Tylor has given in his resignation of the office of keeper of the University Museum, Oxford, to which he was nominated on the death of the late Professor Henry Smith, who had succeeded Professor Phillips, the first occupant of the post, on the opening of the museum in 1857. Professor Tylor will continue to hold the readership in anthropology, to which he was appointed in 1884.

Dr. Earl Lintner, professor in the Technical Institute at Munich, has been made director of the scientific station for the study of brewing in the same city.

Dr. Louis Cobbett and Dr. E. S. St. Barbe Sladen have been appointed by the Royal Commission on Tuberculosis to assist in the experimental work of the commission to be carried out at Stansted. They will reside at the farms and devote the whole of their time to the investigations of the commission.

Owen's College, Manchester, celebrated its jubilee on March 12 and 13. Among those who presented addresses were Professor Becquerel, representing the Paris Academy of Sciences, and Professor Breymann, representing the Bavarian Academy of Sciences.

Mr. Creswell Shearer, of Trinity College, has been nominated to occupy the table at the Zoological Station at Naples, maintained by Cambridge University.

The Smith prizes at Cambridge University have been adjudged as follows: T. H. Havelock, B.A., St. John's College, for his essay 'On the Distribution of Energy in the Continuous Spectrum'; and J. E. Wright, B.A., Trinity College, for his essay, 'Singular Solutions of Differential Equations with Known Infinitesimal Transformations.'

The Department of Astronomy of Columbia University announces two lectures open to the public. On April 8 at 3:30 P.M. Mr. Percival Lowell will lecture on 'Modern Mars,' and on April 16 at the same hour, Dr. S. A. Mitchell will lecture on the recent eclipse expedition.

The Raoult memorial lecture of the Chemical Society, of London, was delivered by Professor van 't Hoff on March 26, in the lecture theater of the Royal Institution.

At a meeting of the members of St.

Thomas's Hospital and Medical School, London, it was decided that steps should be taken to institute a permanent memorial of the connection of the late Sir William MacCormac with the institution. A bust of the eminent surgeon will be placed in the central hall of the hospital, and if the amount of money collected should be in excess of the sum requisite for the bust, some further memorial will be established.

DR. THOMAS CONDON, professor of geology in the University of Oregon, celebrated his eightieth birthday on March 3.

MRS. MARY L. PULSIFER AMES, a writer on botany, has died at San Jose, Cal., aged fifty-seven years.

MR. HENRY HITCHCOCK, a prominent lawyer of St. Louis and one of the trustees of the Carnegie Institution, died on March 15, aged seventy-three years.

PROFESSOR MAXWELL SIMPSON, F.R.S., died on February 26, at the age of eighty-seven years. He had carried forward important researches on organic chemistry, and was for twenty years professor of chemistry in Queen's College, Cork.

PROFESSOR IVAN MUSCHKETOFF, known for his contributions to physical geography, has died at the age of fifty-two years.

THE death is announced of Major-General Pewzoff, known for his explorations in Central Asia, Mongolia and Tibet.

THE accounts of the executors of the late Judge Chas. P. Daly have been filed. It appears that the New York Botanical Garden will receive about $50,000 from his estate.

THE Civil Service Commission calls attention to an examination on April 22 for the position of assistant anthropologist in the Philippines at a salary of $2,400 per annum. At the same time there will be an examination for the position of aid in the Division of Physical and Chemical Geology, U. S. National Museum, at a salary of $1,200 per annum, and for the position of preparateur in the Division of Statigraphic Paleontology at a salary of $720 a year.

AT the Columbia meeting of the Society for Plant Morphology and Physiology, a large group photograph, including all the members then present, was taken and will soon be ready for distribution. It is a platinum print by Falk, on a card 15x14 inches, appropriately lettered, and will cost about $3.50. Members and others wishing copies should send their orders immediately to Dr. Erwin F. Smith, Department of Agriculture, Washington, D. C.

THE newly-organized American Philosophical Association will hold its first meeting at Columbia University, New York City, on March 31 and April 1. Professor J. E. Creighton is president of the Association.

DR. JOHN S. BILLINGS has presented to the New York Botanical Garden his large collection of fungi. It contains much valuable and interesting material; besides numerous specimens collected by Dr. Billings in the vicinity of Washington, D. C., there is a nearly complete series of Ravenel's Texan collections; it is particularly rich in representatives of the Sphaeriales, and includes many specimens of types or of authenticated specimens from the herbaria of Ravenel, Curtis, Schweinitz, Fries, Berkeley, Broome and other older mycologists. The series of herbarium specimens of Mexican plants collected in the States of Jalisco, Mexico, Zacatecas and Lower California by Mr. Leon Diquet and presented to the Garden by the Duke de Loubat, has been mounted for the herbarium. Other noteworthy series of Mexican plants recently added are the J. G. Schaffner collection, secured through the purchase of the Vigener Herbarium, and especially rich in the flora of middle Mexico, particularly the state of San Luis Potosi, and the C. L. Smith collection, consisting of specimens from the region of the Isthmus of Tehuantepec and contiguous states in southern Mexico.

IN experiments on the diffusion of nuclei, Professor C. Barus has recently found that the nucleus from the same source diffuses into water vapor more than 100 times more rapidly than into benzol or other organic vapors, under otherwise like conditions. The rate in the latter case is .017 cm./sec. The important result follows that the nucleus depends for its size on the medium in which it is suspended.

The phenomena as a whole are closely analogous to the suspension of clay in water and in organic liquids, respectively. The particles are smallest in water or in water vapor, while they have grown to relatively enormous sizes in case of the other liquids or vapors.

Mr. Henry E. Koch, of the Biological Department of the University of Cincinnati, has recently made a discovery which places color-photography upon a scientific basis. He has found that certain aniline dyes with which a sensitive plate or paper may be impregnated are sensitive to the light which changes the silver salts; the aniline dye changes to the color of the object which is being photographed. The natural color thus reproduced in the plate or film may be rendered permanent by a fixing process, in the same way that the black and white picture in the silver salt is rendered permanent by the fixing bath.

At the February meeting of the Council of the American Institute of Electrical Engineers, the following resolution, reported by the Committee on Standardization, was unanimously accepted and adopted:

Whereas, The metric system of weights and measures offers very great advantages by its simplicity, consistency and convenience in every-day use, as well as in all engineering calculations and computations, and

Whereas, These advantages have already been demonstrated by the universal adoption and entirely successful use of the metric system in all civilized countries except Great Britain and the United States, and

Whereas, All the electrical units in universal use, such as the volt, ampere, ohm, watt, etc., are metric units, and

Whereas, The industrial use of these electrical units would be much facilitated by the general adoption of the metric system,

Resolved, That this committee unanimously recommends the introduction of the metric system into general use in the United States at as early a date as possible without undue hardship to the industrial interests involved.

Resolved, That this committee favors such legislation by Congress as shall secure the adoption of the metric system by each department of the National Government as speedily as may be consistent with the public welfare.

We learn from *Nature* that the ninth meeting of the Australasian Association for the Advancement of Science was held at Hobart on January 8–16, under the presidency of Captain F. W. Hutton, F.R.S., the subject of whose presidential address was 'Evolution and its Teaching.' The presidents of the sections and the subjects of their addresses were as follows: Mr. R. W. Chapman (Astronomy, Mathematics, Physics and Mechanics), 'Tidal Theory and its Application'; Professor A. M. A. Mica-Smith (Chemistry and Mineralogy), 'The Study of the Chemistry of the Air, and Whither it has Led'; Professor T. S. Hall (Geology and Paleontology), 'The Possibility of Detailed Correlation of Australian Formations with those of the Mother Hemisphere'; Professor W. B. Benham (Biology), 'Earthworms and Paleo-geography'; Rev. Geo. Brown (Geography), 'The Pacific, East and West'; Mr. T. A. Coghlan (Economic and Social Science and Statistics), 'The Statistical Question'; Dr. W. E. Roth (Ethnology and Anthropology), 'On the Games, Sports and Amusements of the North Queensland Aboriginals'; Sir T. Fitzgerald (Sanitary Science and Hygiene), 'The Nature of Diseases'; Professor A. Wall (Mental Science and Education), 'Poetry as a Factor in Education'; Mr. P. Oakden (Architecture and Engineering), no title announced. Many papers were read in each of the sections, and the titles in the official program show that a large proportion was of wide scientific interest. The handbook prepared for the use of the members contains a short historical sketch of Tasmania, and essays on the natural history of the country.

A large number of members of the Royal Society and others have addressed to King Edward the following petition:

That Whereas His Majesty King Charles II., in order to prove that His Majesty did 'look with favour upon all forms of Learning' and particularly 'Philosophical Studies,' and in order that such Learning and Studies should 'shine conspicuously' among his People, did by Charters granted in the 14th, 15th and 21st years of His Reign found the Royal Society for the promotion of such Learning and Studies.

And Whereas the progress of Learning and Philosophical Studies has been great, and scientific methods of inquiry have been applied to many new fields of knowledge since the time of His Majesty King Charles II.

And Whereas Your Petitioners are of opinion that it is desirable that all the Intellectual forces of the Realm should be so organised as to promote the greatest advancement of Scientific Studies within the Empire

And Whereas a large and influential group of representatives of Studies connected with History, Philosophy and Philology have lately presented a petition to Your Majesty praying to be embodied under Royal Charter as an Academy or like institution

And Whereas Your Petitioners are of opinion that such incorporation can be most efficiently provided for in some relationship to the Royal Society

We Your Petitioners humbly pray that Your Majesty may be graciously pleased to cause an Inquiry to be made with a view of instituting a general and formal organisation of all the Studies depending upon Scientific Method now carried on similar to that inaugurated for the Philosophical Studies of the 17th century by the Charters of His Majesty King Charles II.

ACCORDING to the New York *Evening Post* Mr. Andrew Carnegie's recent gifts of libraries affect forty-two towns, as follows:

Reno, Nev.	$15,000	Yankton, S. D.	10,000
Baraboo, Wis.	12,000	Berlin, Ont.	15,000
Greensburg, Md.	15,000	Benton Harbor, Mich.	15,000
London, O.	10,000	Victoria, B. C.	50,000
Blue Island, Ill.	15,000	Little Falls, Minn.	10,000
Littleton, N. H.	15,000	Newton, Kans.	10,000
Paris, Ill.	18,000	Atlantic, Iowa	12,500
Maquoketa, Iowa	10,000	St. Thomas, Ont.	15,000
Redfield, S. D.	10,000	Iowa City, Iowa	25,000
Denver, Col.	200,000	Beatrice, Nebr.	20,000
Las Vegas, N.M.	10,000	Cedar Falls, Iowa	15,000
Goderch, Ont.	10,000	Dennison, Iowa.	10,000
Bozeman, Mont.	15,000	Hampton, Iowa.	10,000
Saratoga, N. Y.	10,000	Athol, Mass.	15,000
San Bernardino, Cal.	15,000	New Albany, Ind.	35,000
Danville, Ind.	10,000	Tipton, Ind.	10,000
Nakoma, Ind.	20,000	Mount Clemens, Mich	15,000
Santa Rosa, Cal.	20,000	ChicagoHeights, Ill.	10,000
Charlotte, Mich.	10,000	Waukesha, Wis.	15,000
Brazil, Ind.	20,000		
Fulton, N. Y.	15,000		
New Brunswick, N. J.	50,000		
Oskaloosa, Iowa	$20,000		

A RECENT enumeration gives a total of 1,476 preparations of the brain in the neurologic division of the museum of Cornell University. Of these 402 are from human adults; 207 from fetuses or embryos; 282 from apes, monkeys and lemurs; 400 from other mammals, and 185 from other vertebrates.

THE Italian Government has accepted the offer of a German syndicate to drain the Pontine marshes, which stretch between the mountains and the coast, with a breadth varying from six to eleven miles, at a cost of $1,000,000. The reclaiming of the marshes is expected to free Rome from malarias. The syndicate has exacted a thirty-year lease of the reclaimed land, which it intends to use for farming and garden purposes.

THE map descriptive of Niagara Falls and the river which formed a part of the United States Geological Survey at the Pan-American Exposition is of special interest. Like all the sheets prepared by the Geological Survey, the map shows in great detail the usual features contained on ordinary map sheets and in addition reveals the relief of the country by the use of contours, or lines passing through all points of equal altitude. Of special interest, however, is the short 'Physical History of the Niagara River,' printed on the reverse side of the map, which traces its life history and the work it has done in excavating the deep gorge below the falls in which are located the famous whirlpool and the rapids just above it. It is interesting to note that the stream is described as not one of the old rivers of the earth, but one of comparative youth. The text also discusses the well-known recession of the falls by which they are slowly eating their way, at the present rate of four or five feet a year, back toward Lake Erie, which they will eventually reach. It touches upon the probable age of the river, or the time which has been consumed in the making of the gorge, on the effect which the great ice sheet of the Glacial Period had in changing its course, and on other features in connection with it which are of unusual interest. The description is accompanied by a bird's-eye view of Niagara River, showing the features described in the text. The map is not only an accurate one of the section, but, with its descriptive features, forms an excellent means of studying some of the most striking problems in physical geography. It can be had on application to the Director of the Geological Survey, Washington, at the usual price of five cents per sheet.

UNIVERSITY AND EDUCATIONAL NEWS.

The Duke of Loubat has given the Collège de France an annuity of $1,200 to found and maintain a professorship for the study of American antiquities. In 1899 he founded a similar professorship in the University of Berlin.

The Columbian University of Washington, D. C., has just completed plans and let contracts for the erection of a new hospital building and a new medical and dental school on H Street, N. W., between Thirteenth and Fourteenth. The buildings will be colonial in style. The hospital will have a frontage of 60 feet to the south, and the medical school building (50x144 feet) will be five stories high. Large new laboratories thoroughly equipped for modern work, well-lighted lecture and reading rooms will afford excellent facilities for medical and dental students.

The University of Cincinnati has received a donation of about $5,000 for the purchase of presses and other machines for the University of Cincinnati Press. Hereafter the University will do all its printing and will print the scientific publications and texts which are published by the teachers in all the departments of the University.

The regents of the University of Michigan have indorsed the action of the engineering faculty, making it obligatory for students to spend six months between the junior and senior years in practical work.

The faculty of McGill University has decided to ask the Dominion Government at the present session of Parliament to enact a law inaugurating a five years' course in medicine instead of four as at present.

The courses offered by the graduate school of Yale University are distributed as follows: Philosophy, 50; social science, history and law, 77; Semitic languages and biblical literature, 59; classical and Indo-Iranian philology, 59; modern languages, 65; physical and natural sciences, 81; mathematics, 29; fine arts, 4; music, 7; physical culture, 3.

The *Bulletin* of the University of the State of Missouri gives the number of professors and instructors who have attended different universities as follows: Harvard, 15; Yale, 1; Columbia, 2; Johns Hopkins, 8; Virginia, 5; North Carolina, 1; Georgia, 1; Michigan, 3; Wisconsin, 2; California, 1; Stanford, 2; Indiana, 1; Missouri, 22; Dartmouth, 2; Chicago, 5; Miami, 1; Minnesota, 1; Lake Forest, 2; Cincinnati, 1; Clark, 3; Cornell, 6; Williams, 1; Lehigh, 1; DePauw, 2; Ohio, 1; Trinity (Toronto), 1; McGill, 1; Heidelberg, 3; Ecole des Beaux Arts, 1; Paris, 5; Berlin, 10; Halle, 2; Munich, 2; Classical School at Athens, 2; Classical School at Rome, 1; Strassburg, 1; Leipzig, 2; Goettingen, 2; University of London, 2.

Of the three European fellowships conferred at Bryn Mawr College, one has been awarded to Miss Marie Reimer, A.B. (Vassar) for work in chemistry, and one to Miss Harriet Brookes, A.B. (McGill), for work in physics.

Mr. R. A. S. Redmayne has been appointed professor of mining in the University of Birmingham, and Mr. Thomas Turner, professor of metallurgy.

The Isaac Newton studentship, Cambridge University, of the value of £250 for the encouragement of study and research in astronomy and physical optics, open to bachelors of arts under the age of 25 years, has been awarded to Mr. T. H. Havelock, B.A., scholar of St. John's College.

Mr. J. S. Budgett, of Trinity College, has been elected to the Balfour Studentship at Cambridge University. The studentship is tenable for three years and the annual value is about $1,000.

Dr. Ernst Beckmann, professor of chemistry at the University at Leipzig, has been called to the newly established chair of chemistry at the University of Berlin.

Dr. J. Piccard, professor of chemistry at the University of Bâsle, and Dr. E. Buguion, professor of anatomy at the University of Lausanne, will this year retire from active teaching.

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, APRIL 4, 1902.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

AMERICAN MORPHOLOGICAL SOCIETY.

I.

AT the annual meeting of the American Morphological Society, held at the University of Chicago December 31, 1901, and January 1 and 2, 1902, the following papers were presented:

The Physiological Zero and the Index of Development for the Egg of the Domestic Fowl, Gallus Domesticus: CHARLES LINCOLN EDWARDS.

From the study of 238 eggs distributed in 23 incubations of about six days each, and from the measurement of 59 unincubated eggs the following conclusions were derived:

1. The physiological zero, or the temperature below which there is no development, previously given by most authors at 28°, and by one at 25°, is established at the degree included between 20° and 21°.

2. The index of development is given for temperatures from 20°–21° to 30.75°.

The first phase shows a very gradual rise in the percentage of development of the embryo to 14 per cent. at 27°–29°, the primitive streak alone showing. The second phase, beginning with notochord, neural plate and groove, and mesodermic somites, presents an abrupt rise to 54.83 per cent. of normal development at 30.75°.

3. The normal average diameter of the blastoderm of the unincubated egg, as determined from the measurement of fifty-nine individuals, is 4.41 mm. with a standard deviation of 0.4792 mm. and a coefficient of variability of 0.1087.

4. The normal average diameter of the area pellucida of the unincubated egg as determined from the measurement of fifty individuals is 2.51 mm. with a standard deviation of 0.3382 mm. and a coefficient of variability of 0.1347.

5. From 136 blastoderms in which primitive streaks have not developed, the form of the area pellucida is 59 19/34 per cent. round, 12½ per cent. nearly round, 23 9/17 per cent. oblong and 4 7/17 per cent. oval.

6. The normal average volume of the egg, as determined from the measurement of 100 individuals, is 51.67 c.c., with a standard deviation of 4.8602 c.c. and a coefficient of variability of 0.0942. In 85 per cent. of fifteen unincubated eggs where the volume was noted the diameter of the blastoderm varies directly with the volume of the egg, but the variates are so evenly distributed about the average that the general averages of the measurements in this paper would not be especially affected by this element.

7. The introduction of successively higher stages, and the increased growth of blastoderms without primitive streaks as the temperature rises, together with a continued growth of the primitive streak with the non-appearance of other features of the embryo at a low temperature, 20°–21° to 27°–28°, would indicate a direct dependence of ontogenetic organization upon warmth.

Differentiation without Cleavage in the Egg of the Annelid Chætopterus pergamentaceus: Frank R. Lillie.

This phenomenon was observed in both fertilized and unfertilized ova. The essential point is briefly this: That by the action of certain solutions the eggs are preserved alive, sometimes for as long as thirty-six to forty-eight hours, although neither cytoplasm nor nucleus divides. During this period the cytoplasm slowly passes through certain well-defined phases of differentiation, the yolk accumulating in a dense mass in the interior and the peripheral cytoplasm becoming vacuolated and ciliated. The ciliated ectoplasm and the yolk-laden endoplasm are analogous to the ectoderm and endoderm of the trochophore, and the phases of differentiation resemble some of the normal processes; though the resulting object can by no stretch of the term be properly called a trochophore.

The solutions employed were sea water with the addition of KCl or $CaCl_2$, or both these salts. The eggs were left in the solutions for an hour and then transferred to sea water. If the solutions were above a certain density, the formation of the polar bodies was suppressed; but this did not interfere with the subsequent differentiation. During the period of time usually occupied by the cleavage the eggs were markedly amœboid; in some cases (especially after $CaCl_2$) throwing out a bewildering number and variety of long pseudopodia, and actually creeping like amœbæ. All intermediate conditions between this and actual cleavage were observed. During this period, in typical cases, the nucleus became enormously enlarged, and some chromatin was diffused through the cell. Fusion of ova frequently took place, and, in solutions containing $CaCl_2$, large numbers frequently fused into a common mass. The nuclear conditions in these large fusion-masses offer an interesting object for study.

At the end of a period slightly longer than in the normal development the ectoplasm became vacuolated and ciliated. By the action of the cilia the eggs often rotated rapidly in the water. In the largest fusion-masses cilia appeared only on restricted areas.

Certain of the phenomena of ontogeny are thus shown to be independent of cell-division. It may be expected that further study of the material and careful analysis of the results will aid in the understanding of the mechanism of the earliest phenomena of development.

In conclusion, acknowledgment was made to the aid received from the subsequent work of A. D. Mead and Jacques Loeb.

The Rate of Growth in Marine Invertebrata: A. D. Mead.

Ingestion and Digestion in Hydra: Elliot R. Downing.

Many observers have noted that the mouth of hydra is capable of great expansion, so that it can swallow comparatively large animals. The mouth is not a simple circular orifice; a cleft runs out from the center of the peristome toward each arm, so that it is divided into as many lobes as there are arms, the lobes alternating with the arms. The circumference of the expanded mouth is therefore as great as the contour of this radiate figure. These lobes at the margin of the peristome are double the thickness of the ordinary body wall on account of the greatly increased length of their endoderm cell. They become thinner toward the mouth and also where they merge into the body wall below the level of the tentacles. They are traversed by longitudinal muscle fibers continued from the body wall.

Ingestion is followed promptly by digestive processes. Within a few minutes after ingestion certain gland cells become apparent in the endoderm. These cells contain a nucleus which rapidly enlarges and becomes granular. As noted in the digestive processes of higher animals, these cells are probably forming enzymes. They rapidly decrease and finally disappear as the ferment is discharged into the body cavity. These gland cells stain best with gentian violet after osmic-Merkel.

The digestive process is rapid. Last June I observed a good-sized hydra ingest a young carp 8 mm. long. Seven hours later, as determined by sectioning, no trace of this remained in the digestive cavity. The digested material is absorbed by the endoderm cells, which after a meal are gorged with food spheres; much of this material, especially the oil, is passed on to the ectoderm cells, where it is stored. The fatty substance accumulated at the periphery of these cells forms a layer of droplets which may be stained an intense black by osmic acid. It is these fat droplets which during life give to hydra its brown color.

The History of the Eye of the Blind Fish Amblyopsis: Carl H. Eigenmann.

The history of the eye of *Amblyopsis* may be divided into four periods:

(*a*) The first extends from the appearance of the eye till the embryo is 4.5 mm. long. This period is characterized by a normal palingenic development, except that cell division is retarded and there is very little growth.

(*b*) The second period extends till the fish is 10 mm. long. It is characterized by the direct development of the eye from the normal embryonic stage reached in the first period to the highest stage reached by the *Amblyopsis* eye.

(*c*) The third, from 10 mm. to about 80 or 100 mm. It is characterized by a number of changes which are positive as contrasted with degenerative. There are also distinct degenerative processes taking place during this period.

(*d*) The fourth, 80–100 mm. to death. It is characterized by degenerative processes only.

The eye of *Amblyopsis* appears at the same stage of growth as in normal fishes developing normal eyes. The eye grows but little after its appearance.

All the developmental processes are retarded and some of them give out prematurely. The most important, if the last, is the cell division and the accompanying growth that provide the material for the eye.

The lens appears at the normal time and in the normal way, but its cells never divide and never lose their embryonic character.

The lens is first to show degenerative steps and disappears entirely before the fish is 10 mm. long.

The optic nerve appears shortly before the fish reaches 5 mm. It does not increase in size with the growth of the fish and disappears in old age.

The scleral cartilages appear when the fish is 10 mm. long; they grow very slowly, possibly till old age.

There is no constant ratio between the extent and degree of ontogenic and phylogenic degeneration.

The eye is approaching the vanishing point through the route indicated by the eye of *Troglichthys*.

There being no causes operative or inhibitive, either within the fish or in the environment, that are not also operative or inhibitive in *Chologaster agassizii* which lives in caves and develops well-formed eyes, it is evident that the causes controlling the development are hereditarily established in the egg by an accumulation of such degenerative changes as are still notable in the later history of the eye of the adult.

The foundations of the eye are normally laid, but the superstructure, instead of continuing the plan with additional material, completes it out of the material provided for the foundations. The development of the foundation of the eye is phylogenic; the stages beyond the foundations are direct.

Asymmetry in the Rattulidæ, and the Biological Significance of Asymmetry in some Lower Organisms: H. S. Jennings.

The Rattulidæ are a family of Rotifera having an unsymmetrical form. The body presents the appearance of having been twisted, so that primitively dorsal structures are on the right side at the anterior end, and on the left side at the posterior end. An oblique ridge on the dorsal surface passes from the rear forward and to the right, ending frequently in one or two teeth on the right side. It was shown that this twisted form is an adaptation to the method of life and behavior of the animals; they swim in a spiral, of which the twisted body forms a segment, and the oblique ridge marks the course of the spiral. The reaction to stimuli is also correlated with this form. It was further pointed out that such an unsymmetrical form is common among small organisms which swim in a spiral course and react to stimuli in the characteristic manner described in the paper; this is true for example of most of the free-swimming Infusoria. If radial symmetry be considered characteristic of a fixed life, bilateral symmetry of an active life in which dorsal and ventral surfaces have different relations with the substratum, we may on similar grounds distinguish an unsymmetrical or spiral type, characteristic of swimming organisms which follow a spiral path, keeping the same side of the body always directed toward the axis of the spiral. A large number of organisms show this type of structure.

On the Early Development of Spermophilus Tridecemlineatus, a new Type of Mammalian Placentation: Thomas G. Lee.

Spermophilus differs from other rodents in a temporary fixation of the blastocyst to the antimesometrial wall of the uterine cavity. Later the blastocyst detaches and the true placenta develops on the mesometrial wall. The uterine lumen resembles a capital T, the cross-bar being the mesometrial side. Tubular glands open on all mucous surfaces, later disappearing in the anti-mesometrial region. The ovum, entering the uterine cavity at the close of segmentation, forms a small blastocyst consisting of an outer or trophoblast layer and an inner cell-mass, which differentiates into ectodermal and entodermal portions. At the antiembryonal pole of the trophoblast a multinucleated syncytial mass develops which projects from the free surface. This fixation mass perforates the uterine epithelium and touches the growing vascular connective tissue. Enlarging, it becomes a rounded mushroom-shaped mass, convex next the connective tissue, cupped next the blastocyst. The thin margins gradually extend between the epithelium and connective tissue. Later numerous root-like processes develop composed of fine longitudinally striated protoplasm; these extend into the connective tissue of the mucosa. The anti-mesometrial portion of the uterine cavity loses its epithelium and rapidly dilates to accommodate the growing blastocyst. The fixation mass becomes a more and more shallow cup and the roots atrophy and disappear; the result being the separation of the blastocyst from its attachment. By means of a zone of trophoblast external to the germinal area the embryonal pole of the blastocyst becomes attached to the margins of the transverse mesometrial portion of the uterine cavity which retains its epithelial lining and forms the site of the true placenta. Later development is similar to that of the European form, *Spermophilus citellus*, described by A. Fleischmann. A detailed description of these stages with plates and discussion of literature will soon be published.

Demonstration of the Placentation of Spermophilus (stereopticon): Thomas G. Lee.

Variation in the Box Elder Bug (Leptocoris): H. B. Ward.

Some Alaskan Sipunculids: H. B. Ward.

Cell-Homology: Edmund B. Wilson.

In an analysis of the conception of cell-homology, it was pointed out that here, as elsewhere, the essential criterion of genetic homology is that of common ancestral descent, and that no purely embryological criterion is in itself adequate. That cell-homologies may be merely incidental or secondary to regional homologies of the egg as a whole applies equally to all forms of genetic homology and constitutes no valid argument against cell-homology; but, owing to the plasticity of cleavage-forms, cell-homologies may be more readily modified or even obliterated than other forms of homology. For practical purposes cells of like prospective value, giving rise to homologous structures, may, irrespective of their origin, be called *equivalent;* those of like ontogenetic origin and position may, irrespective of their fate, be called *homoblastic;* but neither equivalent nor homoblastic cells are necessarily homologous. The term homology (partial or complete) is applicable in cleavages of like pattern which have been derived from a common ancestral type, and in which the corresponding cells are both homoblastic and equivalent. When the cells, though homoblastic, wholly change their equivalence, or when the cleavage-pattern itself wholly changes, the original homology disappears.

Degeneration in Paramœcium and so-called 'Rejuvenescence' without Conjugation: Gary N. Calkins.

Two individuals, A and B, of *Paramœcium caudatum,* from different sources, were isolated February 1, 1901. These were fed on twenty-four-hour hay-infusion and the number of divisions recorded at periods of from one to three days throughout the year, one individual being isolated each time. At the present time (December 30) A is in the four hundredth and B the three hundred and sixtieth generation, and no conjugation has taken place in the direct line of my cultures. Thus far the experiments have yielded the following results:

1. *Paramœcium* unquestionably passes through more or less regular cycles of activity and weakness.

2. The period of weakness is preceded by one of greater dividing activity.

3. The period of weakness ends in death, provided the diet (hay-infusion) remains the same.

4. Beef-extract restores the weakened functions of growth and division, without conjugation.

5. Normal conjugation between A and B, if followed by the same diet (hay-infusion), does not restore these weakened activities, but is soon followed by death.

6. Exogamous conjugation between wild gametes, and followed by hay-infusion diet, results in normal growth, division and life.

7. Endogamous conjugation does not differ from exogamous conjugation. The exconjugants live and divide normally if fed for a time with beef-extract, but die if fed directly with hay-infusion.

8. One intracellular effect of beef-extract upon weakened *Paramœcium* is the formation of 'excretory granules.' Another is the disintegration of the macronucleus.

9. A few conclusions to be drawn are: (*a*) A change of diet is necessary for continued vital activities. (*b*) What we may call parthenogenesis, or the development of gametes without fertilization, may be induced by change of diet. (*c*) Conjugation by itself does not 'rejuvenate.' (*d*) Conjugation probably has some other significance than that usually accepted; what this significance may be is not indicated thus far by my experiments.

Note on Metamerism of the Vertebrate Head: W. A. Locy.

The Median Bundle of the Olfactory Nerve in Elasmobranchs: W. A. Locy.

Fertilization in the Pigeon's Egg: E. H. Harper.

In the pigeon's egg, polyspermy has been found to occur normally. The supernumerary sperm nuclei migrate to the periphery of the germinal disc and give rise to an accessory cleavage. They differ from the cleavage nuclei in the fact that their rate of division is more rapid; in being surrounded by wide areas of liquefaction; in having a finer chromatin network and more slender and elongated chromosomes; and in possessing one-half the somatic number of chromosomes. In their later history as yolk nuclei they divide amitotically. Never more than one sperm nucleus conjugates with the egg nucleus.

In the earliest stage of the fertilized egg observed, the egg was within the mouth of the oviduct. The first polar spindle was present and was surrounded by many sperm nuclei. Spermatozoa penetrate the egg most readily within the region occupied by the germinal vesicle in the ovarian egg, and the pronuclear phenomena also occur about within the limits of this region.

In the first breaking down of the sperm head a number of chromatin vesicles are formed equal to the number of chromosomes in the sperm.

The polar bodies are formed about the time the egg enters the glandular portion of the oviduct. They lie between the vitelline membrane and the cytoplasm.

In cell division, cytoplasmic currents are present. These currents precede nuclear division, and outline the paths by which the daughter nuclei later migrate apart. They are not confined to the immediate neighborhood of the nuclei, but extend into the region of the future blastomeres.

The spindles and asters are very minute in comparison with the size of the blastomeres and the appearance and curved paths of the currents indicate that cytoplasmic division is due to amœboid movements rather than to the tension of astral fibers.

The Development of Color in the Definitive Feather: R. M. STRONG.

The colors of feathers, as was pointed out by Bogdanow ('58), Gadow ('82) and others, are due to the presence of pigment or to special conditions of structure. The pigmentation of the feather takes place in the earlier stages of the development of the feather. The dark brown pigments, commonly classed as melanins, appear to be formed in the cytoplasm of epithelial cells which are differentiated to produce pigment. These pigment cells, or chromatophores, send out branched processes to those cells which are to form pigmented elements of the future feather. Pigment granules pass from these pigment-cell processes into the cells composing the feather fundament. The formation and the distribution of pigment cease before cornification has proceeded far. There is no redistribution of pigment after the feather is fully formed and has burst forth from the sheath enclosing the feather germ.

A New Type of Hyper-metamorphosis: JAMES G. NEEDHAM.

This paper will be published in *Psyche.*

An Experimental Study of Regulation in Stenostoma: C. M. CHILD.

When portions are removed from chains of *Stenostoma* regeneration is complete, provided the piece is not below a certain size. In addition to the regeneration, the piece becomes more slender and narrower, the change first appearing, except under certain conditions, at the posterior end and extending anteriorly until it includes the whole body. The piece does not acquire the same proportions as the original, but approaches them more or less closely.

To explain this change, it is necessary, first, to examine the methods of locomotion and the locomotor structures of *Stenostoma.* The animal, like other rhabdocœls, is covered with cilia which constitute the locomotor organs.

When undisturbed, *Stenostoma* shows a strong tendency to attach itself to the substratum. The attachment by the tail, which is used as a sucker, is especially frequent and the tail adheres more closely than any other part of the ventral surface.

Most of the time when the animal is attached the lateral and dorsal cilia are vibrating and are thus acting in opposition to the organs of attachment; the result is the subjection of the body to a certain amount of mechanical tension. That such tension does exist is evident from a large number of observations.

If we suppose the animal to be attached by the posterior end and the lateral and dorsal cilia vibrating with equal speed and force, the tension upon the tissue at any cross section of the body will be proportional to the number of cilia which are anterior to that cross section, *i. e.,* the tension will be greatest at the posterior end and null at the anterior end of the body, with a complete gradation between the two extremes.

The chains of *Stenostoma* always taper posteriorly, as would be expected if this tension is effective in modifying form.

The elongation and decrease in transverse diameter of pieces are exactly what might be expected if the tension is effective.

And, furthermore, it is possible to prevent the change of form (morphallaxis) by preventing the animals from attaching themselves. The form change occurs very rapidly in *Stenostoma,* being complete in twenty-four hours or less. Pieces were prevented from attaching themselves during twelve hours after operation and then were compared with pieces, originally of the same size, which had been allowed to attach themselves. The pieces which had not been allowed to attach themselves were little changed, while the controls had elongated in some cases nearly half of the original length and tapered strongly to the posterior end.

It was found also that the chains attach themselves more readily to rough than to smooth glass. A little very fine sand on the bottom of a glass vessel is sufficient to cause the animal to attach itself more readily and therefore to change its form more rapidly than a specimen kept in a clean glass jar.

In all these experiments the specimens were kept without food.

The experiments show that form-regulation (morphallaxis) in *Stenostoma* is, at least in large part, purely a mechanical phenomenon, not the effect of stimuli.

Cord and Brain: J. B. Johnston.

Recent studies upon the brain and cranial nerves of lower vertebrates show that the nervous system, exclusive of the sympathetic and higher brain centers, falls into four chief *functional divisions.* These are as follows:

A. Somatic sensory division: Consisting of the free nerve endings and sense organs (neuromasts) in the integument, exclusive of end buds; nerve components innervating these organs (dorsal roots, exclusive of sympathetic fibers, V., VIII. and lateral line roots); and the nerve centers in which these components end (dorsal horn, tuberculum acusticum and cerebellum). Its stimuli give rise to reflexes which affect the animal's relations to its environment, and in higher forms commonly give rise to sensations and conscious reactions.

B. Splanchnic sensory division: Free nerve endings in the lining of the alimentary canal, sense buds in the branchial and mouth cavities, and on the surface of the head and body (end buds); components innervating these (sympathetic fibers in the dorsal roots, X., IX. and VII. roots), and centers in which these components end (Clarke's column and lobus vagi or fasciculus communis with its nuclei). Its stimuli give rise to reflexes which serve the functions of nutrition, respiration, circulation, etc.

C. Somatic motor division: The ventral horn of the cord, the nuclei of the XII., VI., IV. and III. nerves, the somatic motor fasciculus and its 'tween brain nucleus, and the motor components innervating somatic musculature.

D. Splanchnic motor division: The region of the lateral horn in the cord, the nuclei of the X., IX., VII. and V. cranial nerves; and the motor components innervating splanchnic musculature.

In the parts of the brain rostral to the medulla the splanchnic sensory and motor divisions are wholly lacking, while the somatic motor extends forward nearly to the rostral end of the brain axis and the somatic sensory division includes the cerebellum and probably the tectum opticum.

Important parts of the mid, 'tween and fore brain (inferior lobes, central gray, striatum [?], etc.) belong to the same category as the tract and commissural cells of the medulla and cord. The nucleus of the posterior commissure and the olfactory apparatus cannot be compared with any structures in the cord or hind brain. There is no essential resemblance between the olfactory nerve and its central apparatus and the typical cranial nerves and their centers. The olfactory nerve has no segmental value.

The Development of the Postcaval Vein in Didelphys Virginiana: C. F. W. McClure.

The variations in the mode of origin of the postcaval vein of the common opossum are so extreme as to preclude our formulating a typical arrangement for the species as a whole. The different modes of origin which characterize the postcaval vein in the adult are briefly as follows:

1. The postcaval vein may be formed through a union of the iliac veins which takes place *ventral* of the common iliac arteries (type I.);

2. Through a union of the iliac veins which takes place *dorsal* of the common iliac arteries (type II.); or,

3. Through a union of the iliac veins which takes place both *dorsal* and *ventral* of the arteries in question (type III.).

A study of the embryonic development of the posterior tributaries of the postcava shows, I think, how these variations have been derived. Embryos of 8.5, 12, 15 and 22 millimeters in length were examined.

In an embryo 8.5 millimeters in length the umbilical artery, on each side, *passed through a complete foramen* in the postcardinal vein, so that one portion of the circumarterial venous ring lay *ventral* and another *dorsal* of the artery. This foramen was situated near the point of union of the external and internal iliac veins. In a subsequent stage the internal iliac veins approached each other in the median line and fused ventral of the caudal artery to form a common internal iliac vein.

The writer believes that the type of postcaval vein to be assumed by the adult depends upon the loss or persistence of those portions of the circumarterial venous rings which lie dorsal and ventral of the umbilical arteries.

If the atrophy affects the dorsal branches of the circumarterial venous rings, a postcava will result as in type I. If it is the ventral branches of the rings that atrophy, a postcava will result as in type II., but, if dorsal and ventral branches of the rings both persist, a postcava of type III. will be formed.

The Development of Pigmental Color in Insects: W. L. Tower. (Read by title only.)

Progressive Variation in a Given Generation of some Plants and Animals: W. L. Tower. (Read by title only.)

Observations on the Habits of Hyalella dentata Smith: Samuel J. Holmes.

The observations on *Hyalella* that were made related to food habits, thigmotaxis, phototaxis, reactions to pressure and sexual habits. Experiments were performed with the end of determining the mode of sex recognition in *Hyalella*. That sight plays no important part in the process was proved by the fact that males whose eyes were blackened over with asphalt varnish succeeded as well as others in obtaining females. Neither did removal of the first and second pairs of antennæ in the males prevent their obtaining mates. It is therefore improbable that the males are guided to the females by the sense of smell. Several females, some of which were recently torn from males, were placed within a small enclosure of fine wire gauze in a dish of water. Several males were placed in the dish outside the enclosure, but none of them paid the slightest attention to the females, although they seized the females quickly enough when the enclosure was raised and the females were allowed to scatter through the dish. It is only when the males accidentally collide with the females while swimming that any attempt is made to seize them. When a female collides with another amphipod she curls up and remains quiet for a time, when, if not seized, she soon passes on. When two males collide, each apparently attempts to seize the other and carry him about as a female would be carried. Males have the instinct to seize and carry about other amphipods they meet with, and are only prevented from so doing by the similar attempts of the other individual. Males which are mutilated by the removal of the large second pair of gnathopods, so that they are no longer able to make effective resistance, are seized and carried about by other males just as females would be carried. Sex recognition in this species is apparently determined by the different modes in which the two sexes react to the contact of other individuals.

Some Notes on Hybridism, Variation and Irregularities in the Division of the Germ-cell: Michael F. Guyer.

At one stage in the maturation of germ-cells, preceding the true reduction division, bivalent chromosomes are formed ordinarily; that is, only half of the regular number of chromosomes appear, but each of the new chromosomes is apparently double and equivalent to two of the simple type. In the spermatogenesis of hybrids, the formation of the bivalent chromosomes is frequently incomplete or defective, so that the resulting divisions are irregular and unequal. The greater the difference between the two individuals crossed, the more marked is the disturbance in the maturation of the germ-cells of the hybrid offspring. In a paper two years ago before a meeting of the Western Naturalists (abstract, Science, February 16, 1900), I discussed this point in the case of hybrid pigeons and I suggested that these peculiarities in chromosome formation might point to a tendency in the chromatin of each parent species to retain its individuality, and that the extreme variability seen in the offspring of fertile hybrids was possibly to be attributed to this variability in chromatin distribution. In hybrid plants (cannas) I have since determined that practically the same irregularities occur, and, recently, Juel described abnormalities in the germ-cells of hybrid plants which are in nearly every respect parallel to those which I found in the pigeon; hence it seems to me that the same possible interpretation presents itself. Moreover, perhaps the same conception will hold in the case of the many plants, such as the geranium or apple, which will not come true from seed, but require propagation by means of slips or grafts.

To test this I have recently undertaken a study of the formation of the pollen grains in the geranium and I find that in it, as in hybrids, irregularities in the first division of the pollen mother-cell frequently occur, though in a less degree. In answer to the question as to why a plant will come true from a graft or slip and not from seed, it seems possible that we may have a clue in this apparent inability of the chromosomes to fuse normally to form the bivalent type of chromosome. In hybrids it would seem that the chromosomes from each parent lie side by side and divide in an ordinary manner to construct and maintain the body, but that when the germ-cells are to be matured the usual doubling of chromosomes which occurs at such times is incomplete, the result being that the chromatin is unequally distributed to the later cells. In a less degree, the same thing occurs in the pollen cells of such plants as the geranium. No fusion of the chromosomes is necessitated in the slip; hence, they continue to lie side by side and divide in the ordinary way, and the new plant is practically a continuation of the old one.

Relative Variability of Pectens from the East and West Coasts of the United States: C. B. DAVENPORT.

Pecten irradians from Tampa, Florida, and *Pecten ventricosus* from San Diego, California, are closely related species, as the parallelism in color and markings indicates. They are a pair of species that, taken by themselves, favor the view of a recent connection of the Gulf of Mexico and the Pacific Ocean. In respect to the symmetry of the valve and in respect to the globosity (height divided by length), the San Diego form is much the more variable, as measurements and calculations of the index of variability of ten hundred shells prove. This greater variability of the Pacific form is a fact in agreement with what Eigenmann has found for fishes. It is correlated with the greater physiographic changes in recent times in the character of the shore line of southern California as contrasted with Florida.

An Experimental Study of the Development of the Lateral Line in the Frog Embryo: R. G. HARRISON.

The Ovary and the Reproductive Period: F. H. HERRICK.

Whenever it is impossible or impracticable to determine the reproductive periods of an animal by watching its behavior, the structure of the ovary will usually furnish the clue. This is true of the Crustacea, and probably of all other animals.

My present object is not only to illustrate this fact, but also to settle definitely the spawning habits of the American lobster, concerning which doubt and disagreement still abound. To put the specific question briefly: How often does an adult female lobster lay her eggs? The answer is, every two years, as a rule. This same conclusion was reached six years ago, chiefly from a study of the comparative anatomy of the ovary of animals captured at different seasons, and while confident of its general accuracy at that time, it is now possible to supplement it with observations upon the living animals themselves.

In a single generation of ovarian eggs three stages may be conveniently chosen for special study: (1) The initial stage, when the ova of the preceding generation are laid; (2) the intermediate stage, when those eggs are hatched; and (3) the final stage, when the ovarian eggs have reached their full size and are ready to be expelled from the body. The average size attained by the ova at these successive periods can be determined with sufficient accuracy. The time interval between stages 1 and 2 is known to be approximately one year. The ratio of growth between stages 1 and 2 is approximately equal to the ratio of the volume of the laid egg and that of ova in the second stage, from which it follows that the time interval between stages 2 and 3 is also one year. Further anatomical facts and experiments with living animals also confirm this conclusion.

The adult spawning lobster therefore does not lay her eggs each year, as some have maintained, but every other year, although this normal biennial period is likely to be shortened or lengthened in individual cases. The evidence on which these conclusions rest is ample, and will be given in detail at a later time.

M. M. METCALF,
Secretary.

[*To be continued.*] 571

TWENTY YEARS OF SECTION H, ANTHROPOLOGY.

The American Association for the Advancement of Science very early manifested an interest in anthropology. In 1849, at the second meeting of the Association, Professor S. S. Haldeman read a paper entitled 'Linguistic Ethnology.' Communications relating to anthropology were presented at almost every meeting until 1869, when increasing interest in the subject led to the formation of a subsection of 'Ethnology' under the general section of natural history. In 1873, the name of the subsection was changed to 'Anthropology.' At the Buffalo Meeting in 1876, anthropology was recognized as a permanent subsection of natural history.

When the Association was finally divided into sections, as now constituted, Section H fell to anthropology. The first program of Section H was presented at Montreal in 1882, Professor Alexander Winchell presiding in the absence of Sir Daniel Wilson.

By a curious coincidence, Section H of the British Association for the Advancement of Science is also devoted to anthropology, and its first session was held in Montreal in 1884, two years after the initial meeting of our own Section H in that city. The story of the early struggles of anthropology for recognition in the British Association, as told by Sir William Flower,* is strikingly similar to that of its early struggles for recognition here.

Eighty-six papers on anthropological subjects were read prior to the organization of Section H in 1882. From 1882 to 1901, inclusive, the communications numbered 589, or an average of more than 29 per meeting. These figures refer only to the annual meetings, no records having been kept of the winter programs. The maximum number of papers, 45, were presented at the Boston meeting of 1898, and the minimum number, 11, were presented at Montreal in 1882.

* *Report of the British Association for the Advancement of Science*, 1894, p. 762.

Judging from the nature of the communications, the interest of anthropologists has been somewhat unevenly divided among four general branches of anthropology, viz., archeology, ethnology, somatology and general anthropology. Archeology was the favorite subject prior to 1882, as it has been since.

The following tabulation is offered as a means of making a numerical comparison of the work done in the four general divisions of the subject:

	1849–1881	1882–1901	Totals.
Archeology	48	261	309
Ethnology	22	211	233
Somatology	14	80	94
General Anthropology	2	37	39
Totals	86	589	675

I have followed Brinton's* scheme of classification, grouping sociology, religion, mythology, linguistics and folk-lore under ethnology, and psychology under somatology.

In so far as the communications presented admit of geographical classification, it has been found that the members of the section have devoted themselves almost exclusively to the American continent. The reasons for such a choice are obvious. While science is supposed not to recognize political boundaries, problems that have a geographical basis go logically to resident workers, other things being equal. Legislation has also come to favor the home archeologist as opposed to the foreign. The study of anthropology naturally begins at home, a course always favored by questions of transportation.

* 'Proposed Classification and International Nomenclature of the Anthropologic Sciences,' *Proc. Amer. Assoc. for the Adv. of Science*, 1892.

Patriotism is a more or less constant factor in inspiring one with a love for everything pertaining to the home-land; archeology and ethnology, as well as form of government and commercial, artistic or literary supremacy. We cherish some relic of a vanished race all the more because it was found on the old homestead. Local, national, New World pride has evidently had much to do with our choice of subjects for special research. Add to all these considerations a vast and virgin continent awaiting the anthropologist, and there is little wonder he has given such a relatively small portion of his time to the Old World, or the islands of the sea.

Out of a total of 589 papers presented in the last twenty years only 32, or 5.4 per cent., were devoted solely to foreign lands, foreign being understood to mean all lands other than the American continent and immediately adjoining islands; while 39 papers, or 6.6 per cent., were comparative studies involving both American and other lands.

Of the vice-presidential addresses, four were on archeology, nine on ethnology, four on somatology and two on general anthropology. Eleven vice-presidents chose American subjects, eight chose comparative, and not one dealt with a purely foreign problem.

In order to determine the geographic distribution of subjects in Section H of the British Association, recourse was had to the 'Reports' covering the four years 1893–96. During that time, 136 papers (reports not included) were read, distributed geographically as follows:

Europe (including British Isles)	55, or 39.9 per cent.
Other lands	50, or 36.2 per cent.
Studies involving both Europe and other lands	33, or 23.9 per cent.

Records of the anthropological section of the French Association for the Advancement of Science during the same period, 1893–96, were analyzed with the following results:

Total number of papers read	116
Studies in Europe	86, or 74.2 per cent.
Studies in other lands	21, or 18.1 per cent.
Studies involving both Europe and other lands	9, or 7.7 per cent.

The German Anthropological Society may be considered as the equivalent of Section H in the British or American Association for the Advancement of Science. Applying the same geographical test to the work of the German Society of Anthropology as it appears in the *Berichte* for 1897–1900, inclusive, the results are as follows:

Total number of papers read	88
Studies in Europe	50, or 56.9 per cent.
Studies in other lands	14, or 15.9 per cent.
Studies involving both Europe and other lands	24, or 27.2 per cent.

To arrive at a juster comparison of the scope and trend of the work done in anthropology by the several associations, the same time unit should be used. This would call for the records of our sectional work from 1893 to 1896,* inclusive, instead of for the whole twenty years; and the records for these four years furnish the following data:

Total number of papers presented	136
Subjects pertaining to the Americas	105, or 77.3 per cent.
Subjects pertaining to other lands	7, or 5.1 per cent.
Subjects involving both the Americas and other lands	24, or 17.6 per cent.

The percentage of purely foreign studies is even lower for the short period of four years than for the long period of twenty years. On the other hand, there is a

* The German *Berichte* for 1897–1900 were selected because they were more accessible at the time of these investigations.

marked increase in the number of communications relating both to foreign lands and to the Americas.

The nature of the work under review is such as to render mathematical exactness impossible. I have endeavored to make the foregoing averages approximate the truth, and believe they can be relied upon to show that American anthropologists have been working in relatively greater isolation than have European anthropologists.

The cosmopolitan character of the programs of the several associations in question is found to be in direct ratio, not only to the area of the colonies and dependencies of the several countries, but also to the tonnage of their merchant marine engaged especially in the foreign trade. The anthropologist's horizon is constantly under limitations imposed by his government's colonial or commercial policy.

With colonies and protectorates beyond the confines of Europe aggregating over 11,000,000 square miles in extent, including India, and with a merchant marine engaged exclusively in the foreign trade, much larger than that of any other country (8,043,860 tons in 1899), open especially to them, the English anthropologists are brought into contact with foreign problems at so many points, it would be strange indeed did they not improve the opportunities thus afforded.

The colonies and dependencies of France cover an area (1901) of 3,740,000 square miles, with a population of 56,000,000. The area of German colonies and dependencies amounts to 1,027,120 square miles with a population of 14,687,000.

The United States became a 'world power' only three years ago. Enough time has not elapsed to show the influence of that step on the programs of Section H, but if we expand along with our opportunities, it is safe to say that an analysis of the work we shall do in the next twenty years will show different results from that of our record for the epoch just closed.

We may not be able to improve much on the quality or even the quantity, but, with an enlarged horizon, the work should become less and less local and fragmentary. I believe we are at the threshold of a new epoch in which the many interdependent and partially solved problems of the past shall be completed and thereby make possible vast progress in correlative and synthetic anthropology.

George Grant MacCurdy.

New Haven, Connecticut.

COLLEGE WORK FOR AGRICULTURISTS.

Authentic information regarding the progress made in the State of New York in the promotion of scientific methods in agriculture and the part taken by science and scientific men in their advancement has often been sought, and yet we rarely find a clear statement of the extensive work which has been done and is still being carried on in aid of scientific and intensive agriculture. The extent of this work is enormous and its value to the state is vastly more than proportionally valuable. It is mainly performed at the experiment station, and in the university extension work, of the College of Agriculture of the 'Land Grant College' of the state, at Ithaca, and at the experiment station at Geneva. A recent statement by the president of Cornell University is the first which has given us a concise, yet definite and satisfying, account of this work. We abstract the principal parts of this statement:

"By the Morrill Act of July 2, 1862, Congress enacted that there should be granted to the several states certain amounts of public land, from the sale of which there should be established a perpetual fund, 'the interest of which shall be inviolably appropriated * * * to the endowment, support and maintenance of at least one college where the leading object shall be, *without excluding other scientific and classical studies and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts.*' The provisions of this act were accepted by New York State; whereupon there was handed over to the State Comptroller New York's share of the congressional land script. The State legislature then passed an act (April 27, 1865) establishing Cornell University and appropriating to it the income from the sale of the script in the State's possession; and providing in the Charter of the University that 'the leading object of the corporation hereby created shall be to teach such branches of learning as are related to agriculture and the mechanic arts, including military tactics. * * * But such other branches of science and knowledge may be embraced in the plan of instruction and investigation pertaining to the University as the trustees may deem useful and proper.' The College Land Script Fund whose income was thus appropriated to Cornell University amounts to $688,576.12. The State, as guardian of the fund, has turned it into the State treasury,—having issued to Cornell University a certificate of indebtedness on which it pays an annual interest at the rate of five per cent. amounting to $34,428.80. This is applied to 'instruction in such branches as are related to agriculture and the mechanic arts, etc.'

"Some years later Congress saw that the provision made for the support of the colleges established under the Morrill Act of 1862 was not sufficient, and accordingly, by the second Morrill Act of August 30, 1890, it was enacted that there be 'appropriated to each state for the more complete endowment and maintenance of colleges for the benefit of agriculture and the mechanic arts established under the provisions of the federal act of July 2, 1862, the sum of $15,000,' to be annually increased by $1,000 until the sum of $25,000 was reached, 'and the amount thereafter to be paid to each state and territory shall be $25,000 to be applied only to instruction *in agriculture, the mechanic arts, the English language and the various branches of mathematical, physical, natural and economic science,* with special reference to their application in the industries of life, and to the facilities for such instruction.' This congressional appropriation is now $25,000 annually.

"There is therefore available for 'instruction in agriculture, the mechanic arts, the English language and the various branches of mathematical, physical, natural and economic science' $59,428.80 received from the bounty of the United States. This is all that Cornell University receives from the federal government for any purpose. To prevent misapprehension I should perhaps add that the Federal Agricultural Experiment Station, for which there is an annual appropriation of $13,500, is located at Cornell. But while the University lends its buildings and grounds and gives freely the services of its administrative officers for the conduct of the experiments and the management of the finances of the station, it gets no financial return, and not a cent of the Experiment Station funds can be used for purposes of instruction. * * *

"In return for the federal land grant, Cornell University gives free instruction, in all departments, to four students annually from each of the assembly districts of the State, making in all 600 free students annually.

"It gives free instruction also to all

agricultural students, of whom at present nearly 200 are enrolled. Thus Cornell University is a benefactor of the State of New York to the extent of conferring upon it annually free instruction for 800 students. On the average it costs a large and well-equipped university like Cornell about $300 for the education of each student. *Cornell, therefore, annually gives to the people of the State of New York not much less than $250,000.*

"The entire amount received from the United States—$59,428.80 annually—does not begin to provide instruction even in 'such branches of learning as are related to agriculture' alone. * * * The total cost of maintaining the Agricultural College at Cornell University is found to be $141,061.27.

"Towards the maintenance of this Agricultural College by Cornell University, the State of New York does not contribute. It appropriated, a few years ago, $50,000 for a Dairy building, which was intended to form one wing of a great State Hall of Agriculture. But that hall remains unbuilt.

"I should mention the $35,000 granted to the College of Agriculture by chapter 430 of the laws of 1899, which can be applied only to the special object for which it was granted, and that is the promotion of agricultural knowledge throughout the State by university extension methods. The College is happy to aid the State in so useful and helpful a work, but the College itself receives no benefit from it. For the sake of completeness I will add that the State maintains at Cornell University a New York State College of Forestry, for which it makes an annual appropriation of $10,000, and a New York State College of Veterinary Medicine, for which it makes an annual appropriation of $25,000. *No other appropriation of any kind, either for the University or for State institutions located here, is received by Cornell from the State of New York.* All the rest of the revenues of the University is derived from private endowments. * * *

"Since the College of Agriculture was established it has given instruction to more than sixteen hundred students in residence at Ithaca, and it has become one of the foremost colleges of its kind in the United States. * * *

"There are in attendance at the present time some two hundred students in the various courses. Tuition is free in all courses. During the last five years there have been from ten to twenty graduate students in the University each year who have selected both their major and minor subjects or their major subject in the College of Agriculture. This indicates the opinion that students from other colleges have of the work being done here.

"In addition to the students in residence, we are teaching a vast number of students scattered throughout the State by means of correspondence courses. This work is for the promotion of agricultural knowledge throughout the State. There are enrolled in the Farmers' Reading Course department 30,000 students; in the Farmers' Wives' Reading Course, 8,000 students; in the Junior Naturalists' Club, about 30,000 pupils organized into 1,700 clubs; in the Home Nature Study Course, about 1,500 teachers. * * *

"Nearly five hundred farmers have conducted experiments on their own farms under the careful supervision of members of the teaching force. This is in addition to the investigations carried on at the University. There is scarcely a subject connected with fruit or field crops that has not been studied from close range in a majority of the counties of the State.

"I cannot state accurately how many

lectures before farmers' organizations have been delivered since the College was established, but they certainly number several thousand. In addition to all this, the College has done a vast work in helping the farmers out of their difficulties by personal correspondence. From five to ten thousand letters per year in answer to questions are written by the staff. This work alone is a great tax upon the College, but the benefits derived are so great that the practice still continues of answering, to the best of our ability, all questions related to agriculture, directly or remotely.

"The Experiment Station, a department of the College of Agriculture, has published 196 bulletins, in editions averaging more than 20,000 each, and fourteen annual reports. Whenever there is a serious outbreak of insects or fungi, a specialist is dispatched immediately to make investigations and to help overcome the difficulty. * * *

"Agricultural students have gone to all parts of the State and carried with them the light of science to aid the farmer in his arduous and difficult, though independent and noble, calling. Professors, by their investigations on the diseases that attack grains and fruits and flocks and herds, have saved millions of dollars to the State. The Cornell method of combating the pear-sylla saved over a million dollars to a single county. Methods of orcharding have added noticeably to the prosperity of farmers and fruit growers."

CORNELL UNIVERSITY. R. H. THURSTON.

SCIENTIFIC BOOKS.

Die heterogenen Gleichgewichte, vom Standpunkte der Phasenlehre. Erstes Heft: *Die Phasenlehre: Systeme aus einer Komponente.* By H. W. BAKHUIS ROOZEBOOM. Braunschweig, Friedrich Vieweg und Sohn. 1901. 14x22 cm. Pp. xiii+217. Price, paper, 5.50 Marks.

Every one who lectures on a subject feels the necessity of presenting it, so far as may be, in a systematic, coherent manner. For this reason we make the 'periodic law' the basis of lectures on inorganic chemistry, while we classify organic substances according to their constitution formulas. In physical chemistry the order of treatment has been based largely on the physical state of the system, gaseous, liquid or solid. It is an open question whether the orthodox classification is or is not the best in the case of inorganic and organic chemistry; but it is certainly not satisfactory for physical chemistry. The ideal classification for this last subject is based on the phase rule of Willard Gibbs and depends primarily on the number of components and secondarily on the degrees of freedom. By the components we mean the substances from which the system can be made, and we classify our material first as one-component, two-component, three-component systems, and so on, usually grouping systems containing more than three components under the single head of multi-component systems. We next subdivide each group according to the degrees of freedom, this depending on the relation between the number of independently variable components and the number of phases. By phases we mean the physically distinct portions of the system, such as the solution or liquid phase, the vapor phase, the solid phase or phases. When the only factors to be considered with relation to equilibrium are the pressure, temperature and the relative masses of the components, the state of the system is fixed when there are two more phases than there are components. Such a system is called an invariant system. When there is only one more phase than there are components, the system is called a univariant system, and it is said to have one degree of freedom because the state is not fixed until we settle arbitrarily the value of one of the independent variables. When the number of phases equals the number of components, the system is a divariant one having two degrees of freedom. Each decrease in the number of phases means an equal increase in the degrees of freedom.

The classification according to components and degrees of freedom is known as the phase-rule classification. It is broad enough to include all facts pertaining to equilibrium and yet clearly enough defined so that everything has its own place. It is therefore an ideal classification, or perhaps the ideal classification for chemical equilibrium. It is more comprehensive than the periodic law or constitution formulas, and chemistry as a whole will some day be presented from this point of view. The phase rule is to the science of chemistry what the steel frame is to a building, the periodic law, constitution formulas, the mass law, the laws of electrochemistry, etc., being the brick walls. Just as we can build a small building safely of bricks and wood, while the steel construction is the only wise one for a sky scraper, so we have managed to get along satisfactorily hitherto without the phase-rule classification; but the rapid development of quantitative chemistry necessitates a new arrangement.

The book by Professor Roozeboom does not claim to revolutionize chemistry in the manner just outlined. Our ignorance is still too great to permit such a scheme being carried through to-day, though the direction in which we are tending and must tend is very clear. This book deals chiefly with the qualitative side of equilibrium and this first volume with systems containing one component only. It is, however, a conscious and deliberate step in the direction of the goal I have indicated and no one is better qualified to take this step than Roozeboom. We owe the phase rule to Gibbs; but it was Roozeboom who brought out the significance of it; who changed it from an interesting but apparently unimportant mathematical generalization to the safe guide in all matters of equilibrium and to the future basis of systematic chemistry. In this first volume the author begins with the discussion of the boundary curves for liquid and vapor, solid and vapor, solid and liquid. The triple point at the intersection of these three curves is next considered. We then pass back to the equilibrium between two stable solid phases and to the triple point with solid, solid and vapor in equilibrium. A chapter on flowing crystals follows, in which it is shown that these are properly to be considered as a solid phase and that the first inversion point is one for solid, solid and vapor. Next comes a chapter on instable triple points in the case of enantiotropic systems, and then one on the behavior of monotropic substances. The volume closes with a chapter on the triple point, solid, solid liquid; one on the triple point, solid, solid, solid; and a final chapter in which the general question of uniform and non-uniform pressure is considered.

WILDER D. BANCROFT.

Die wissenschaftlichen Grundlagen der analytischen Chemie, elementar dargestellt. Von W. OSTWALD. Dritte, vermehrte Auflage. Leipzig, Wilhelm Engelmann. 1901. 13x21 cm. Pp. xi+221. Price, bound, 7 Marks.

The book is divided into two nearly equal parts, the first containing general theory and the second the application. The first chapter deals with the conditions for recognizing a substance and might well have been fuller. When two or more properties of two substances coincide, the other properties usually do and the substances are identical. This is true, but not complete. For instance, the converse does not follow. We can have substances, notably some of the radio-active substances where certain properties can differ markedly and yet the two substances be the same from a chemical point of view. This raises the question as to what properties, if any, are to be considered fundamental.

The second chapter gives the methods of mechanical separation, together with the theory of washing a precipitate. The third chapter treats of separation by distillation or solution. The fourth chapter is devoted to the electrolytic dissociation theory and the fifth to the question of measurement. In the second portion of the book the author takes up the different elements in the usual analytical groups and discusses them. In an appendix are given a number of interesting lecture experiments.

The opinion one forms of this book will depend on one's point of view. If one looks upon it as a book for those beginning analytical chemistry, it is excellent because it contains many things which every one ought to know, and because one can justify many of the mistakes and omissions on the ground that the beginners should first get hold of the general outlines of the subject, leaving the troublesome exceptions until later.

If one looks upon the book as a work for analytical chemists, for men who know the practical details of their subject and who would like to get a broader and more general view of the theoretical side, the book is not up to standard. Such men will be annoyed by the quantitative application of the mass law to the solubility of strong electrolytes, by the tacit implication that nitrates are not soluble in nitric acid, by the assumption that continued addition of a salt with no common ion will cause continued increase of solubility, by the statement that ion reactions are necessarily more rapid than reactions where ions are supposed not to take part. If they have read the recent work of Kahlenberg on the action of hydrochloric acid on oleates in benzene solution, they may even ask themselves whether the electrolytic dissociation theory is necessary in order to account for results in aqueous solutions which are paralleled in solutions which do not conduct and where the electrolytic dissociation theory therefore does not apply.

WILDER D. BANCROFT.

The Engineering Index; Five Years, 1896–1900. Edited by HENRY HARRISON SUPLEE. New York and London, The Engineering Magazine. 1901. 8vo. Pp. 1030. Price, $7.50.

The first and second volumes of this index to engineering literature, covering the years 1884–1895, were issued under the editorship of Professor J. B. Johnson from notes published monthly in the *Journal of the Association of Engineering Societies.* Since January 1, 1896, this work has been done by the *Engineering Magazine,* and the present third volume of the 'Index' is the gratifying result. It contains about a hundred pages more than the first and second volumes combined, while the amount of matter is more than twice as much, owing to the arrangement of the page in two columns and to the smaller type. The number of periodicals indexed is about 350, nearly six times as great as in the second volume.

The index is a subject one, the titles of the articles or papers being classified under headings, each of which is subdivided into minor ones. For example, under 'Education' there are found twenty-one titles relating to engineering education in general, these being placed in alphabetic order according to the first word of the title; then follow about eighty special articles classified under sixty subdivisions, beginning with Admission Requirements and ending with Yorkshire College. Cross references are also given under both the general headings and their subdivisions, thus rendering it easy to follow special lines of inquiry in different directions. The styles of type used for the major and minor headings are good ones, although perhaps a little greater clearness might be secured with styles somewhat lighter.

The first volume of this series was called by Professor Johnson 'The Descriptive Index of Engineering Literature,' because there was added to the title of each paper a brief note giving an outline of its contents or an estimate of its value. While the name has unfortunately been changed, this excellent feature of descriptive notes has been retained, and these are of great assistance to the index searcher, for they usually give a clearer idea of the paper than can be obtained from its title. For example, under the heading 'Gas Engine' the title 'A Modern Motor' is somewhat vague, but the added note, 'The advantages of gas engines in points of economy, efficiency, cleanliness and safety,' immediately tells the reader whether or not the article is likely to be of value to him. In this volume the additional useful feature of noting the approximate number of words in each article has been introduced. The articles indexed from periodicals in foreign languages appear to be about ten or fifteen per cent. of the total number; the titles of these are given in English translation, followed by the original in parentheses.

For the use of the expert or specialist the index is not a complete one, as only the more important articles in the transactions of engineering societies are included. The oldest and most influential engineering society, the Institution of Civil Engineers of Great Britain, issues annually four volumes of proceedings, but these are not included in the list of periodicals indexed. Some important special German publications, like the *Zeitschrift für Vermessungswesen,* a high authority on geodesy and precise surveying, and *Baumaterialienkunde,* the leading journal on the testing of materials, are also not included. A few special American periodicals, like *Cement* and the *Metallographist,* are likewise omitted, but it is plain that it would be a difficult task to index all the literature of all the branches of the vast field of engineering.

Any index to literature should be prepared with the definite aim of being useful to a definite class of people. This has been done in the case of the present volume, the definite class being the readers of the *Engineering Magazine,* who include men of all professions having interest in transportation, manufacturing and construction. To these the index is admirably adapted, and it would be difficult to outline a plan that would produce better results for the engineering profession in general. The volume may appear somewhat incomplete to engineers who are experts in a special line like hydraulics, but when they turn to other headings they are likely to be astonished at the number of references and the number of periodicals that have been indexed. The expert may properly object to including titles of popular articles on engineering topics from the monthly literary magazines, but beyond this he has cause only for congratulation. The work has been carefully prepared on a comprehensive plan, and it should immediately find a place in every public library as a record of progress in the science and art of engineering, and in every technical library as an indispensable aid to research.

Mansfield Merriman.

Lehigh University.

Insects Injurious to Staple Crops. By E. Dwight Sanderson, B.S., Agr. New York, John Wiley & Sons. 1902.

Under the above title Professor Sanderson, entomologist of the Delaware Agricultural Experiment Station, has brought out a handbook of 295 pages, with 162 illustrations, the subject matter being disposed in 25 chapters. Besides topics of a general nature the following are discussed: 'Insects Injurious to Grains and Grasses,' 'to Wheat,' 'to Indian Corn,' 'to Stored Grain,' 'to Clover,' 'to Cotton,' 'to Tobacco,' 'to the Potato,' 'to the Sugar-beet,' and 'to the Hop-plant.' Although the author in his preface unreservedly disclaims any originality for the contents of his work, and states that, unless otherwise noted, all the facts are merely compilations of the writings of others, it is in some respects, in the writer's opinion, the most useful book covering the subject of the insect enemies to staple crops that is extant. The typography is excellent, and most of the illustrations are well produced. In its arrangement it is, in some respects, not unlike the 'Farmers' Bulletins' that have been published on entomology by the Division of Entomology of the U. S. Department of Agriculture; and the presented matter is grouped together in such manner that any one desiring information on any of the topics considered can find ready access to them.

The main incentive for the compilation of this work, as the author states, is due to the fact that our sources of information concerning injurious insects are so widely scattered throughout the circulars, bulletins and reports of the state agricultural experiment stations and of the U. S. Department of Agriculture, a few books on economic entomology and many other publications, that the farmer, provided he be not also an economic entomologist, is unable to obtain the facts which he desires concerning any given insect, unless it so happens that the species is treated in popular form in some publication from his own state. Again, most works upon American economic entomology give such meager descriptions and accounts of the life-histories of insects that the agriculturist cannot secure a clear understanding of the subject in which he is interested.

The author might have gone farther in stating that many publications supposedly written in a popular manner—at least designed for distribution among the agricultural population—are so filled with technical terms as to render them unintelligible to the average reader. Many of the writers who publish in this manner fail to furnish summary accounts of what has been given in detail, and thus the reader is obliged to peruse many pages which have no interest to him in order to secure the object desired, which is usually an approximate knowledge of the appearance of the insect, the nature of its ravages, life-history, and, above all, the means for its reduction.

It might have been added that every year brings new pests to our shores, which in time become disseminated by flight and commerce through our country, and that this necessitates the publication of new popular works or of new editions of the old in order to consider these foreign pests and bring the works up to date.

In estimating the money value of the injury done by insects the author states that when we include that done to fruits, truck crops, domestic animals and timber, $300,000,000 is a conservative estimate of the price these apparently insignificant creatures annually cost this country.

One good feature of the author's treatment of his subjects consists in the space given to the consideration of general farm practices that may be used in combating insect pests. In the treatment of this chapter he points out that few farmers in planning the management of their land for crops for the season consider the effect which any given procedure will have upon injurious insects with which they may have to contend. Farmers too frequently fail to look far ahead, and rotation of crops when practiced is more for the sake of soil improvement than for the reduction of insect attack, and yet crop rotation is the only remedy for many species of insects when they occur in injurious numbers over large areas, *e. g.*, in fields of grain. Among other methods of tillage, clean farming, the destruction of weeds that might harbor injurious species, the burning over of fields after the crops have been made, fall plowing, drainage, the judicious use of fertilizers, the employment of trap crops, and the selection of the proper time for planting, are considered. Due attention is also given to the structure and development of insects, to beneficial insects, the value which accrues from the use of poultry as insect exterminators, and to insecticides, and the means for preparing and applying them.

Professor Sanderson's work is well fitted for the class of persons whom it is designed to reach, and it should have a large sale.

F. H. CHITTENDEN.

SCIENTIFIC JOURNALS AND ARTICLES.

THE *Journal of Comparative Neurology* for March contains two papers by J. E. Johnston on 'The Brain of *Petromyzon*,' and the 'Primitive Functional Divisions of the Nervous System.' The structure and connections of the nuclei of the cranial nerves in *Petromyzon* are closely similar to those of *Acipenser* previously described by the same author. Especially noteworthy is the presence of a large post-auditory lateral line root and a lobus lineæ lateralis corresponding to that of selachians and *Acipenser*. The fasciculus communis root of the facialis and the central relations of the sensory IX. and X. nerves are recognized and described for the first time. The cerebellum is in a very primitive condition histologically, the Purkinje cells being represented by simple large cells similar to those of the acusticum. In the forebrain the illusion of a well-developed cortex is due to the crowding and telescoping of the parts by pressure from the upper lip. The nuclei and fiber tracts are shown to be strictly comparable to those of the brain of other fishes. There is no cortex. The olfactory lobe contains a large number of slightly differentiated cells which serve as the end-nucleus of the olfactory nerve. In the second paper the author defines the longitudinal zones of the spinal cord and brain and the peripheral components and end-organs related to each.

The American Naturalist for March commences with observations on 'A Remarkable Occurrence of the Fly, *Bibio fraternus* Loen' by James G. Needham, the writer noting that several counts showed an average, on the ground, of 15 to a square foot, and that there were forty acres of *Bibio* territory. Even more remarkable was 'An Unusual Occurrence of *Dinoflagellata* on the California Coast' described by H. B. Torrey. The organism was a species of *Gonyaulax* and it caused the death of large numbers of fishes, holothurians and crustaceans, probably the putrefactive changes produced by the death of vast numbers of *Gonyaulax* itself. Annah Putnam Hazen describes 'Regeneration in *Hydractinia* and *Podocoryne*,' and James A. G. Rheen discusses 'The Standing of *Pteropus Haldemani* Hallowell' which he considers as a synonym of *Epomophorus gambianus* Ogilby. Finally there is a long and valuable article by John H. Lovell on 'The Colors of Northern Polypetalous Flowers' considered not only in their relation to insects but to the origin of the colors themselves.

The Popular Science Monthly for April opens with a discussion of the question 'Is this a Degenerate Age?' by J. J. Stevenson, who evidently considers that it is not. Frank H. Bigelow describes 'The Formation and Motions of Clouds,' showing the necessity for a study of the higher regions of the atmosphere in order to enhance the accuracy of weather forecasts, while under the title 'Contributions to Biology from Investigations on the Breeding Salmon' Yandell Henderson reviews the work of Miescher and gives some of the more important results of his observations. Frank Thilly discusses the question 'What is Philosophy?' and Edwin Grant Dexter presents 'A Study of Calms,' showing their apparent effect upon life phenomena. 'Our Foreign Commerce in 1901' is considered by Frederic Emory, showing what advances have been made in foreign trade and what may still be done in that direction, and Frank K. Cameron treats of 'The Soil as an Economic and Social Factor,' making a plea for more serious consideration of the subject. J. H. Gore tells of the proposed 'Draining of the Zuider Zee' and David Starr Jordan of 'The Evolution of Fishes.' Finally we have some notes on Scientific Literature and the Progress of Science, the whole making an extremely good number.

SOCIETIES AND ACADEMIES.

THE SCIENCE CLUB OF THE UNIVERSITY OF WISCONSIN.

At the January meeting of the Club Dr. Victor Lenher described some curious results of an investigation of the telluride minerals. He has observed that when metallic tellurium and a gold solution are brought together, the gold is completely precipitated, while the replaced tellurium passes into solution. The natural tellurides of gold, when brought in contact with chloride of gold, precipitate gold from solution, and when only a little gold solution is used they completely bleach the yellow solution. Not only does this reaction show why gold is not infrequently found as a pseudomorph in the telluride localities, but it also casts considerable doubt on the true chemical character of the tellurides. As the fusion of gold with tellurium gives an alloy which precipitates gold from solution, this method of preparing an artificial telluride has been unsuccessful. Hydrogen telluride introduced into a gold solution was found to act as a reducing agent, precipitating pure gold containing no trace of tellurium. As sulphur chloride and nitric acid extract tellurium from these minerals, leaving noble metal as a residue, grave doubt seems to be cast as to these minerals being true chemical compounds.

On February 27 Professor Louis Kahlenberg lectured before the Club on the subject, 'Chemical Action and the Theory of Electrolytic Dissociation.' After a brief explanation of the theory of electrolytic dissociation, the lecturer stated that adherents of the theory have claimed that instantaneous chemical action, and even all chemical action, is due to the presence of free, charged ions, in other words, that instantaneous chemical changes take place only in conducting solutions. This claim is based on the fact that aqueous solutions of acids, salts and bases are conductors of electricity, and that when such solutions are mixed, chemical changes occur in them instantly in most cases. In this connection a number of typical experiments of instantaneous precipitations by double decomposition in aqueous solutions were exhibited. Solutions of silver nitrate were treated with solutions of the chlorides of hydrogen, iron, sodium, potassium, etc.; in each case a white precipitate of silver chloride was instantly formed. Solution of copper nitrate in water was treated with hydrogen sulphide and copper sulphide was thrown down at once, etc.

The lecturer explained that such instantaneous chemical changes are, however, not at all confined to solutions that conduct electricity. Absolutely dry hydrogen chloride, ammonia, hydrogen sulphide, phosphorus trichloride, arsenic trichloride, antimony trichloride, tin tetrachloride and silicon tetrachloride, as well as the oleates of copper, nickel, iron and manganese, are soluble in hydrocarbons—benzine, for instance—and such solutions are most excellent insulators or non-conductors of electricity. These solutions have much the same outward appearance as conducting aqueous solutions. It was shown experimentally that when copper oleate solution in benzine is treated with the chlorides of hydrogen, phosphorus, arsenic, antimony, tin, or silicon, in the same solvent, there forms instantly in each case a heavy brown precipitate which is anhydrous cupric chloride. It is obvious that the formation of cupric chloride in these non-conducting solutions is perfectly analogous to the precipitation of silver chloride from the aqueous conducting solutions above mentioned.

Further instantaneous precipitations in these non-conducting hydrocarbon solutions were demonstrated experimentally, such as the formation of cupric sulphide, ammonium chloride, nickel chloride, cobalt chloride, etc. It was thus conclusively shown that instantaneous precipitations take place in non-conducting as well as in conducting solutions, and that the changes are perfectly alike in character. From this it follows that it cannot be claimed that instantaneous chemical action takes place in conducting solutions *because* they are conductors, or, in the language of the dissociation theory, because they contain free, charged ions.

Molecular weight determinations of the sulphates of copper, iron, nickel, cobalt, etc., when dissolved in water, show that these salts are not dissociated; yet these solutions are good conductors of electricity. On the other hand, abnormally low molecular weights are observed in some solutions that are nevertheless non-conductors. Again, according to boiling-point determinations, common salt in water would be dissociated more in concentrated than in dilute solutions, which is absurd. It has further been demonstrated that solutions of acid sodium tartrate, as well as solutions of other acid salts, are far more sour to the taste and more toxic in their action toward plants than they ought to be according to the theory of electrolytic dissociation. From this array of facts, which has been published in a series of articles in the *Bulletin of the University of Wisconsin* and the *Journal of Physical Chemistry*, Professor Kahlenberg concludes that *the theory of electrolytic dissociation is untenable.*

At present scientists have no adequate explanation as to why certain solids—*e. g.*, metals—conduct electricity, and certain other solids—*e. g.*, wax or glass—do not. It is therefore not surprising that the real reason that some solutions conduct and others do not is yet unknown. A further careful, experimental study of solutions in various solvents will no doubt throw light upon this subject.

C. K. LEITH.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 548th regular meeting was held March 1, 1902.

Under informal communications several speakers described unusual appearances of rainbows, and Mr. Marcus Baker gave a brief statement of the present status of the Carnegie Institution.

The first regular paper was by Mr. D. L. Hazard, on 'The Secular Variation of the Magnetic Declination in the United States.'

This change in the direction of the compass needle appears to be of a periodic character, requiring several hundred years for its complete development and amounting in the compact part of the United States to 5°–8°. The Coast and Geodetic Survey has followed up the phenomenon by observations for the past fifty years, and has now found it possible to deduce certain general relations between the geographic location of a place and the terms of the periodic formula representing the secular change in declination there. By means of these relations tables have been prepared giving the secular change in declination in each state and territory, and these tables were used in preparing the data for the isogonic chart of the United States for 1902 which has just been issued by the Coast and Geodetic Survey.

In the discussion that followed, Mr. Baker referred to the voluminous magnetic records of the General Land Office, discussed by Mr. Gannett. Mr. Bauer told of the expedition now in the field to locate the magnetic North Pole; and Mr. O. J. Klotz, of Ottawa, spoke of his own work based on the Canadian observations.

The next paper was by Mr. C. F. Marvin, of the Weather Bureau, on 'Anemometer Comparisons and the Use of Ball Bearings.' The methods employed in testing anemometers on whirling machines were described, and the advantages gained by making the tests in the open air during more or less windy weather pointed out. The artificial wind produced by the whirling-machine motion, combined with the natural wind, gives a resultant wind of a constantly changing velocity which resembles closely the gusty winds of nature. From the present state of knowledge of the Robinson anemometer problem, it appears that each type of anemometer requires to be investigated on its own merits. Anemometers of the same pattern, dimensions, construction and moment of inertia will agree within less than one per cent. In the standard Weather Bureau anemometer the old Robinson law that the cups move one third as fast as the wind is found to be true only for velocities between five and ten miles per hour. The cup centers move relatively much faster at higher velocities. Thoroughly satisfactory tests have not been made at high velocities, but the indicated velocities of seventy-five to one hundred miles per hour obtained from time to time in gales and storms are undoubtedly too high.

The formula for the standard instruments is found to be $V=0.263+2.953v-.0407v^2$; where v is the velocity of the center of the cups and V is the velocity of the wind, by observation up to about 35 miles per hour.

Speaking of the friction of anemometers it was stated that the popular impression that friction exerted an important influence on the indications of the anemometer was a mistake, and that it was easy to construct instruments even without ball bearings and keep them in such a condition that the friction was an unimportant factor in ordinary meteorological work. Friction is of importance only in the measurement of the most feeble air currents. These conclusions resulted from tests made with the whirling machine, and have recently been entirely confirmed by a six-month comparison of two standard Weather Bureau anemometers, exactly alike in all respects except that one instrument was fitted with ball bearings of approved construction, while the other instrument was an old one with the ordinary rubbing bearings. In a total run of 31,600 miles the ball-bearing anemometer gained 46 miles, viz., 0.15 per cent., on the anemometer with ordinary bearings. This slight difference was doubtless due quite as much to accidental causes as to the large difference in friction which was perfectly apparent to the ordinary perception.

CHARLES K. WEAD,
Secretary.

ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

THE 327th meeting was held February 24. The Secretary to the Board of Managers announced the election to active membership of Dr. O. F. Cook and Lieut. W. E. Safford, U. S. N.

A Chilkat blanket loom with blanket in process of manufacture was exhibited by Dr.

Hough in the absence of Lieut. G. T. Emmons, U. S. N.

These blankets or fringed mantles of ceremonial character are invariably decorated with a symbolic design of the bear in yellow, blue, black and white. The loom consists of two uprights set in blocks, supporting a beam from which hang the unstretched warp threads of mountain sheep's wool twisted with bark fiber. The woof of dyed wool is twined by hand with the warp, the woman following a design drawn upon a board.

Dr. J. Walter Fewkes presented a communication entitled 'Sky God Personations in Hopi Worship.' Dr. Fewkes said that Hopi impersonations are made by means of masks, a dance with masks or by symbols as idols, pictures or images. The sky god is prominent in two great festivals, the dramatization of the return of the clan ancients or catchinas and their departure. In the former, he is a sun-sky-god personation called Ahuli, the 'returning one,' and in the latter Eototo, a god of growth, leads the ancients back. In the winter solstice ceremony the sky god is in form of a bird. The sky god is male and the earth god is female.

In discussing the paper Professor McGee said that man is constrained by custom more in uncivilized life. They personify certain potencies in common customs; later, these become ceremonies.

Dr. Fewkes' paper led the way to the discussion of the next topic, 'Animism, Totemism and Totemic Impersonations,' by Miss Alice C. Fletcher, Dr. A. E. Jenks, J. N. B. Hewitt, Francis LaFlesche and others. Miss Fletcher said that among the Sioux there is nothing answering to the sky god. The prominence of the sky god as a general term is rather fundamental. The Indian mind is like our own as to the beliefs; we are not yet free as to our minds. The conception of a god by the Indian would not be that of a single god, but dual, the union and manifestation of male and female principles.

Mr. Francis LaFlesche gave a legend of the Omaha and Osage, bearing on the origin of totems. When they were as one tribe they were very poor. They said 'No one can help us but the magic power of Wakanda.' The children put clay on their faces and prayed to Wakanda. Then they got power to make bows and arrows and they blessed the bows and arrows, and in order to preserve the art they set apart a clan. They made houses, etc., and divided the families into clans. The buffalo, elk and turtle, for instance, are not worshipped as totem animals, but are a means through which Wakanda is worshipped. Mr. LaFlesche describes the way men get Wakanda. A hole in shape of a house is made in the ground beneath the grass roots, and the man stands before it and cries to Wakanda; he makes no definite petition, but cries for strength. Perhaps a wolf appears; it is a vision; he preserves that vision by killing a wolf, and takes the skin, or an ear, or tail, and this becomes his totem from Wakanda.

Mr. Hewitt spoke of the Iroquois god that holds up the sky. The legend relates that he was born from the armpit of his mother; he said he came from the sky. His brother is called 'Flint.' In the beginning animals were asked to support human beings, hence came totems. Personal totems originate in a dream at the age of puberty.

Miss Fletcher said in explanation that Wakanda is not seen, or felt, or heard and is only manifest through lesser powers.

WALTER HOUGH.

THE GEOLOGICAL SOCIETY OF WASHINGTON.

AT the meeting of the Society on March 12 the first paper, by Mr. George I. Adams, was entitled 'Lithologic Phases of the Pennsylvanian and Permian of Kansas, Indian Territory and Oklahoma.' As stated by Mr. Adams, the succession of formations in Kansas, Indian Territory and Oklahoma, the lower of which are of Coal Measure or Pennsylvanian, and the upper of Permian age, forms an unbroken series. Within the area of their occurrence they exhibit several lithologic phases. The section in Kansas may be briefly described as: (1) Basal shales and sandstones with coal beds, (2) limestones interstratified with shales and some coal beds, (3) limestones interstratified with shales which carry no coal, and (4) shales which are gypsiferous. In Indian Territory and Oklahoma the limestones thin out and disappear from the section approximately along the Arkansas River. The striking feature of the series south of the Arkansas is the transition of brown sandstones and carbonaceous shales with coal beds to red sandstones and shales. The line marking approximately the limit of the red color cuts diagonally across the stratification. The Red Beds, so-called, are accordingly equivalent in part to divisions 2, 3 and 4 of the Kansas section, with which they are in strike. Their lower portion is Coal Measure or Pennsylvanian in age, and the higher horizons in western Oklahoma are true Permian.

Mr. F. B. Weeks presented a paper on 'Gold-bearing Quartzites of Eastern Nevada.' In the Great Basin region the base of the sedimentaries is exposed in only a few localities. It consists of a coarse conglomerate of loosely cemented fragments of the underlying crystalline rocks, which passes rapidly into well-defined quartzites. These quartzites vary in thickness from a few hundred feet to twelve thousand feet, and are succeeded by a shale band carrying a Lower Cambrian fauna.

In many of the Great Basin ranges the lowest sedimentaries exposed are quartzites, having similar stratigraphic relations. They are usually light-colored, fine-grained rocks, and are known to be auriferous at a few localities. In these areas the strata have been faulted and crushed, and the series is composed of a succession of massive beds and of zones of crushed quartzites. No dikes or evidences of injection of vein material which affected the deposition of ore-bearing solutions have been found. At certain localities veins have been supposed to exist, but examination of the material in thin section reveals its quartzitic character. The pay ore is found in the zones of crushed quartzites and along fracture planes in the massive beds.

From well authenticated reports of assays of material derived from prospects in the massive beds, which had not been affected by faulting, it was found that these beds contain from five to ten dollars in gold. It was suggested that the zones of crushed quartzite had been enriched by percolating waters which had derived their ore-bearing solutions from the overlying quartzite beds, and that in the latter the gold was probably associated with the sands on the sea beach from which these quartzites were formed, perhaps in the same manner as we find it in certain beach sands of the present day. It is desirable that data should be obtained to show how widespread is the occurrence of gold in the quartzites of this region.

A paper entitled 'Notes on a (Hitherto Undescribed) Meteorite from Admire, Kansas,' was presented by Mr. G. P. Merrill. The Kansas meteorite was described by Mr. Merrill as belonging to Brezina's rökicky group, of which the meteorite of Eagle Station, Carroll County, Kentucky, is the only representative thus far found in America. The mineral composition was given as olivine, metallic iron, schreibersite, troilite, chromite and lawrencite.

The striking and most interesting feature of the stone as described was the pronounced brecciated structure, the olivines which occurred in single crystals and aggregates from one to thirty millimeters in diameter being almost universally fractured, and many of them in a decidedly angular condition. The metallic iron was described as occurring in the form of a binding constituent, the meteorite being therefore a breccia of olivine fragments with a metallic cement. It was noted that this metallic portion, however, occurred in two forms, the one compact and taking readily a high silvery polish, and the other less dense and dull gray.

Chemical analysis of the dull iron showed it to be not plessite, as ordinarily assumed, but a spongy mass consisting of metallic iron, troilite and lawrencite, or both; the lawrencite in such cases manifesting itself very quickly through oxidation and the exudation of a greenish iron chloride passing over rapidly into an oxide.

Starting out from the margin of these areas were acicular crystals, which it was assumed were incipient crystallizations of the metallic iron resulting from the reduction of the chloride. From the fact that the metallic portions were found penetrating into the olivines and along the lines of fracture, it was also assumed that the iron was altogether secondary and posterior to the shattering of the silicate.

The meteorite will be described in detail in the *Proceedings of the U. S. National Museum.*

ALFRED H. BROOKS,
Secretary.

NEW YORK ACADEMY OF SCIENCES.
SECTION OF ANTHROPOLOGY AND PSYCHOLOGY.

A MEETING was held on February 28. Mr. J. H. Bair reported on some quantitative studies in sensory and motor association. His experiments have been carried out by aid of a typewriter, the subject reacting to different stimuli by striking different keys. Curves were presented showing the rate of formation of association. If, after the stimuli have been presented many times in the same order, the order is then changed, the association is interfered with, and the more so the firmer it has become. If the typewriter keys are interchanged, so that the reaction to each stimulus must be changed, this interferes still more with the association. These results showed, then, that the association of definite sense impressions with definite motor reactions was more persistent than the association of sense impressions with other sense impressions following in serial order, or than the association of movements with other movements following in serial order.

In the discussion of this paper, several other facts were mentioned, showing the importance of motor reactions in the formation of association. Professor Thorndike had observed that good visualizers, who are able to picture mentally a page of printed matter that they have read, yet cannot read off the pictured words; apparently because the visual images are not associated with motor responses.

Mr. J. B. Miner spoke on 'Involuntary Muscular Responses to Rhythmic Stimuli.' He described some experiments conducted by himself at Columbia and Minnesota universities, in which tracings were obtained for nonvoluntary hand and head movements when the subjects listened to a series of uniform sounds. It has been noted by Thaddeus L. Bolton and others in their investigation of rhythm that such a series of sounds appears not uniform, but as if coming in groups of two or more sounds. The muscle responses obtained correspond with this perception of rhythm, one wave coinciding with each rhythmic group. The movements recorded strikingly agree with another phenomenon of rhythm in that a motor wave shows for each stimulus when the sounds came slowly (forty per minute), but when the rapidity of the sounds was increased the wave encompassed two, three and even four sounds. This agrees with the introspective observation that the subjective group includes more units as the sounds come more rapidly. On the basis of the data of muscular responses Mr. Miner believes that an adequate physiological explanation of rhythm may be formulated, while organic rhythms alone would not furnish a completely correlated activity.

Dr. Clark Wissler reported some ergograph experiments showing that the contracting muscle presents a power series which is constant, whether the resistance is applied by a spring or by a weight. While this power series is weakened by fatigue, the resistance value of any point in the muscle series is the same for a weight or for a spring. In other words, there appears no difference between the fatigue produced by weights and springs when estimated in terms of the muscle series.

R. S. WOODWORTH,
Secretary.

SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY.

THE Section met at the Chemist Club on the evening of March 3. The first paper of the evening was by Mr. Charles C. Trowbridge, on the 'Physical Nature of Persistent Meteor Trains.' Mr. Trowbridge gave a list of forty meteor trains which had remained visible to the naked eye for from two minutes to more than one hour. The trains were all seen by reliable observers. Several tables were exhibited, giving the size, shape and color of recently observed meteor trains.

Mr. Trowbridge gave his views as to the most probable composition of meteor trains, and presented several hypotheses which might account for their long-continued luminosity. The hypotheses advanced were the following: (1) Incandescence of the particles of the train; (2) phosphorescence of the train; (3) electrical discharges; (4) reflection of the light from the sun, moon or stars by the particles of the train; (5) electrons striking the meteoric dust or the air particles in or about the train, causing a fluorescent glow similar to that in a Crookes tube. The source of the electrons may be either the highly heated meteor, in which case the long-continued luminosity of the train must be accounted for by a retardation of the fluorescence, possibly due to the low temperature, or the electrons may come from the sun; in this case the explanation would be similar to that lately given by Arrhenius for the light of the aurora. The author stated that this last hypothesis had not, so far as he knew, been previously advanced, and that the balance of evidence seemed to show that the luminosity of the persistent trains must be primarily caused by energy of an electrical nature. The subject is one of practical importance, owing to its bearing on meteorology.

The paper by Dr. S. C. Mitchell gave the results of observations on the flash spectrum taken by him at Sawah Loento, Sumatra, during the eclipse of May 18, 1901. Dr. Mitchell became, by the courtesy of the astronomical director of the Naval Observatory, a member of the eclipse expedition sent out by this government. The spectroscope employed was a Rowland objective plane grating of 15,000 lines, used in connection with a cœlostat. The weather experienced at Sawah Loento was like that at almost every astronomical location in Sumatra, cloudy throughout totality. However, through clouds, a spectrum of the flash at third contact was obtained which showed 374 bright lines between F and H. Investigations into the reasons for the differences of intensities in the flash and the Fraunhofer spectrum showed that the intensities depend on the heights to which the reversing layers of the different metallic elements around the sun extend. It was found possible to arrange the elements in three groups according to their atomic weights.

Comparisons were made with Dr. Norman Lockyer's list of 'enhanced' lines, or those stronger in the spark than in the arc, in order, if possible, to confirm Lockyer's idea that the 'enhanced' lines play an important rôle in the chromosphere spectrum. Fifty-seven per cent. of the 'enhanced' lines of titanium were found in the flash, but at the same time all of these lines corresponded without exception to strong lines in the sun. On the other hand, so many cases were found where a strong 'enhanced' line was not matched in the sun by a strong Fraunhofer line, nor by any line in the flash spectrum, that it seemed that the measures did not support Lockyer's opinion.

Section adjourned.

F. L. Tufts,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

At the meeting of the Academy on the evening of March 3, about thirty-five persons present, Mr. L. T. Genung, of St. Louis, gave a general discussion of the Lepidoptera, their structural characteristics, habits and adaptations. He exhibited some of the more striking specimens of the Denton collection of butterflies, recently presented to the Academy of Science, and discussed the meaning of the various colors.

A paper by Mr. C. F. Baker, entitled 'A Revision of the Elephantopeæ, I.,' was presented by title.

Two persons were elected to active membership.

William Trelease,
Recording Secretary.

THE COLORADO ACADEMY OF SCIENCE.

At the annual meeting of the Academy, held February 11, 1902, in rooms of the State Historical and Natural History Society, State House, Denver, Colorado, officers were elected, and chairmen of sections appointed February 27, resulting in the selection of the following for the year 1902:

President, A. M. Collett; *First Vice-President,* Mrs. Cornelia Miles; *Second Vice-President,* Z. X.

Snyder; *Secretary and Treasurer*, Will. C. Ferril; *Executive Committee*, George L. Cannon, Ellsworth Bethel, Charles I. Hays, and *ex officio*, A. M. Collett and Will C. Ferril.

Sections and chairman of each, as follows: *Botany*, Ellsworth Bethel; *Zoology*, Alva H. Felger; *Geology*, George L. Cannon; *Microscopy*, Dr. J. B. Kinley; *Meteorology and Physical Science*, N. M. Fenneman; *Nature Study*, S. Arthur Johnson; *Anthropology and Ethnology*, Dr. A. L. Bennett.

The Colorado Academy of Science is limited in its membership to those of the State Historical and Natural History Society, who may be engaged in scientific work and study.

WILL. C. FERRIL,
Secretary.

THE ELISHA MITCHELL SCIENTIFIC SOCIETY.

THE 140th meeting of the Society was held on March 11 at the University of North Carolina.

The following papers were read:

'Enzymes': Dr. A. S. WHEELER.

'Reversible Action of Enzymes': Dr. R. H. WHITEHEAD.

'Molecular Attraction': Dr. J. E. MILLS.

CHAS. BASKERVILLE,
Secretary.

NEW YORK ASSOCIATION OF BIOLOGY TEACHERS.

THE first meeting for the current year of the New York Association of Biology Teachers was held at 43 Hancock Street, Brooklyn, N. Y., on January 31, 1902.

The following officers were elected for the year:

President, Dr. H. R. Linville, DeWitt Clinton High School; *Vice-President*, Dr. E. F. Byrnes, Girls' High School; *Secretary*, George W. Hunter, Jr., DeWitt Clinton High School; *Treasurer*, Miss M. F. Goddard, Peter Cooper High School.

Two papers were read, entitled, 'The Pedagogical and Ethical Content of Biology,' by Miss E. F. Byrnes, and 'The History of Zoology in the Secondary Schools of the United States,' by Miss Marion R. Brown, of the Erasmus Hall High School.

The purpose of the club is to discuss and, if possible, to determine, the best methods of teaching biology in the secondary schools. The club is now entering upon the third year of a very successful existence with a much increased membership.

G. W. HUNTER, JR.,
Secretary.

DISCUSSION AND CORRESPONDENCE.

MOVEMENTS TOWARD UNION AMONG GEOGRAPHERS.

THE recent publication in SCIENCE of letters from Professor Russell, Professor Davis, and Mr. Stanley Brown recalls various other movements toward union among geographers. One of the earlier of these led to the founding of the American Geographical Society in New York; another to the institution of the National Geographic Society, with headquarters in Washington; others to the establishment of geographic clubs or societies in several centers; and still others to the enlargement of the geographic organization in Philadelphia first from a club to a society, then to a geographic institute. At least two of these organizations (those headquartered in New York and Washington, respectively) were originally designed to meet precisely such needs as those outlined by Professors Russell and Davis, together with the equally obvious need of diffusing the elements of geographic knowledge through public meetings and periodical publications; yet in both cases the latter function assumed such prominence as measurably to divert attention from the primary purpose. In both societies the modification in plan came about gradually—and it is probable that in both the changes grew out of the natural effort to balance income and expenditure in such wise as to please the majority of the members at each stage of progress. It is true, as the recent correspondents have pointed out, that the present organization of American geographers in a number of societies fails to meet all professional requirements; but it would seem to be an open question whether the needs might not be met more effectively and economically in some existing organization than by adding another to the already overwhelming list of American scientific societies.

Some of the events in the history of the National Geographic Society seem peculiarly pertinent in this connection. The Society was founded in 1888, primarily to meet just such needs of working geographers as those felt to-day in Michigan and Harvard Universities; for a time the needs were met by meetings largely of technical character, and by a quarterly magazine devoted chiefly to technical papers; and in a somewhat later stage the magazine was reduced to a series of technical memoirs published in brochure form. During this early period various working geographers made important contributions to the science through this medium, technical papers by both Professor Davis and Professor Russell ranking high among these contributions. Gradually the interest of the meetings increased and extended to persons not engaged in geographic work, and to meet their desires the communications were made more popular; and about the same time the magazine was changed into a monthly of largely popular character. This transformation of the Society was never wholly acceptable to the working element, and various efforts were made to oppose it. Thus, early in the last decade, Dr. T. C. Mendenhall, then Superintendent of the U. S. Coast and Geodetic Survey and a member of the Society's board, led a movement toward creating a class of fellows designed to include the investigating and teaching geographers affiliated with the Society; the proposal passed the Board of Managers with only two dissenting votes, but failed of adoption by the Society at large. Thus again, in 1895, some of the working geographers of the Society undertook to establish a series of more technical papers complementary to the magazine, under the designation 'National Geographic Society Monographs'; of these one volume was published—at a financial loss so serious as to forbid continuance. Thus, too, repeated efforts have been made to bring working geographers together in different centers; a well-attended meeting, devoted primarily to technical papers and discussions, was held in Toronto in connection with the British Association for the Advancement of Science in 1897; another meeting was held in connection with the American Association and the Geological Society of America in Boston in 1898, at which the papers and discussions were chiefly technical and the attendance and interest were fair; yet the experiments raised a question as to whether it is feasible for working geographers to assemble in summer when so many of their number are in the field. Despite these discouragements, working members of the Society have persisted in efforts to render the organization an appropriate nucleus for the geographers and geographic activity of the United States. As a step in this direction the Society was, during 1901, rendered national in character as well as in name by merging the classes of resident and non-resident members into the single class of members, and by providing that the Board of Managers shall be chosen from the entire country rather than from Washington alone. Some of the members, including the president, Dr. Alexander Graham Bell, urged that a class of scientific geographers, to be known as fellows, should be established in connection with this extension of membership, Dr. Bell's opinion on this subject appearing in several addresses before the Society; but the majority of the board were of opinion that the two propositions had better be kept separate. Accordingly, the modification of the constitution required for establishing a class of scientific geographers was not taken up last year, but is now pending, with every probability of favorable action. Connected with this change is a proposition to provide for technical publication in the form of a series of papers to be issued in brochure form, and to be known as 'National Geographic Society Memoirs.' Should the pending changes be made, the National Geographic Society will comprise: (1) A large and distinctly national membership (at present numbering about 2,500, distributed throughout all of the States and Territories) including nearly all of the working geographers of the country, (2) a distinctly national class of fellows designed to include all scientific geographers in the United States, and (3) a board of managers selected from all parts of the country, with only a sufficient number resident in Washington to meet convenience and legal requirements as to quorum, etc.; while its work will be both scientific and popular, the former comprising (*a*) technical meetings in Washington and such other centers as may be desired, and (*b*) a technical publication distributed primarily among the fellows to serve as a record of original geographic work, and the latter comprising (*a*) popular lectures not only in Washington, but in other cities, and (*b*) an illustrated magazine of largely popular character, but designed to serve as a convenient medium for geographic publication. Should the plan for the technical memoirs fail of approval by the Society at large, the publication committee propose including the technical matter in the monthly magazine.

It is, perhaps, unfortunate that later developments in the National Geographic Society have not been more promptly and widely announced; yet it is by no means to be regretted that the delay has led to expressions from other quarters which seem to be precisely in line with the plans and policies of this organization.

W J McGee,
Vice-President National Geographic Society.

BALDWIN'S SOCIAL AND ETHICAL INTERPRETATIONS.

To the Editor of Science: I have received, evidently in common with many other sociological *confrères,* a printed copy of a letter addressed by Professor Albion W. Small, of the University of Chicago, to both Professors Baldwin and Giddings. This publication gives renewed impetus to the unfortunate controversy raised by Professor Baldwin in an article published in the January number of the *Psychological Review.* May I be allowed to express, on the subject, the opinion of an outsider, which is also the opinion of the majority of workers who think that the advancement of social science is in no way promoted by such personal quarrels?

The facts of the case are known. In answer to a fair and, let me say, pertinent and conclusive criticism of his work on 'Social and Ethical Interpretations' by Professor Giddings, Professor Baldwin found no better answer than to cast upon his critic the reproach of 'poaching' upon his preserves. Professor Baldwin's answer was conceived in such a way as to convey the impression that the word 'poaching' was simply a quotation from a review of Professor Giddings' 'Elements of Sociology,' previously published by Dr. Small. But the latter, besides showing that the word in question was contained only *in a private letter,* openly and frankly disclaims all responsibility for the construction placed upon it by Professor Baldwin, and clearly states that by using it he did not mean "anything more than 'out of bounds,' *i. e.,* plowing in a field that belongs more properly to another" which is *eine ganz andere Sache.*

In the face of Professor Small's statement, Professor Baldwin is, of course, left to take the whole responsibility for the offensive construction which he has placed upon the word of his colleague. That is what he has done in the 'Correction' published in the March number of the *Psychological Review.* It is to be remarked, however, that the terms of this 'Correction' are strikingly ambiguous. The reader might be led to believe that Professor Small considers Baldwin's mistake in the interpretation of his word, 'immaterial.' As a matter of fact, as shown by Professor Small's letter, he refers very distinctly the 'immateriality' of the mistake, not to the use of the word, but to its source, which is, again, *eine ganz andere Sache.*

What remains, after this, is a clear implication of plagiarism against Professor Giddings.

Let us say, once for all, that Professor Baldwin can lay no claim whatever to the discovery that has changed our view of social life by lending a definite support of facts to the psychic conception of social relations. The discovery is that of 'imitation' by Tarde. In spite of Professor Baldwin's futile attempt to minimize Tarde's merit by associating the name of the latter with that of Bagehot, Tarde is and will always be, for every unprejudiced student, the discoverer of imitation as a great psychological force underlying both social and mental development. Bagehot only gave us vague hints and tentative guesses. Tarde gave us the clear notion of the elementary social fact, the unit of social investigation. Professor Baldwin has undoubtedly the merit of having diligently and industriously followed the path shown by the French master, of having seized his original intuition and carried it into his own psychological field as a vivifying ferment of research. An important contribution of Professor Baldwin to knowledge is the genetic study of imitation as the typical form of organic and mental accommodation to environment, as the method through which the mental development of the individual is accomplished. But, beyond this distinctly psychological work, mainly embodied in his volume on 'Mental Development in the Child and the Race,' Professor Baldwin has never brought to light any fact in the line of social evolution that had not been previously intimated or actually mentioned by Tarde. His 'Social and Ethical Interpretations' is undoubtedly an extremely interesting work. But, apart from the 'Dialectic of Personal Growth' which is practically a chapter belonging to the earlier volume, the remainder of the book is substantially *a transcription of Tarde in another key.* This can be conclusively shown by actual comparison of certain chapters and passages of Professor Baldwin's book with Tarde's 'Les Lois de l'Imitation' and, especially, 'La Logique Sociale.' Even the distinction between the *matter* or content of social organization and its *functional method* or process, so much emphasized by Professor Baldwin, is his own only in so far as the scholastic turn of the formula is concerned. Apart from the Aristotelian terminology adopted by Baldwin, the distinction had been clearly made by Tarde long ago. We must say, furthermore, that, while Professor Baldwin limits the social matter to *thoughts* or intellectual states—a conception justly criticized by Professor Giddings as insufficient and incomplete, Tarde showed the contents of social organization to be not only thoughts, but feelings—'*croyances et désirs*'—not thought merely nor feeling merely, but a combination of the two, a view which, as Professor Giddings remarks, is 'most consistent both with evolutionary hypotheses and with psychological conclusions' ('Democracy and Empire,' p. 39). This, of course, is not intended to underrate in any way the value of Professor Baldwin's work. The advancement of science is not only promoted by the discovery of new facts, but also by the verification and propagation of other men's discoveries. Professor Baldwin belongs to the latter class of scientists. His book on 'Social Interpretations,' while bringing forward no new facts, has just the great merit of having helped to propagate the substance of Tarde's doctrines. This work of vulgarization has been so thorough and painstaking as to justify the statement that Professor Baldwin's book is one of the most important contributions of American thought to the advancement of social science.

Since, however, Professor Baldwin has no claim to any discovery in the field of sociology, it becomes interesting to see how he can prove that Professor Giddings—a sociologist—has 'poached' upon his preserves.

The evidence brought forward by Professor Baldwin in support of his charge of dishonesty against Professor Giddings consists:

1. Of a reference to Professor Small's review of Giddings' 'Elements.' This is ruled out because Professor Small himself has distinctly repudiated the interpretation placed upon his word 'poaching,' and moreover because in the passage of his review quoted by Baldwin, Professor Small explicitly acknowledges that Baldwin's 'ejective stage' is one thing and Giddings' 'ejective interpretation' is another thing. In the face of Professor Small's statement, the whole question becomes one of due credit rendered for the term and the concept 'eject.' These, as all well-informed students of psychology know, originated, not with Professor Baldwin, but with the lamented William Kingdon Clifford, and to Clifford, as shown by Professor Giddings' essay on 'The Psychology of Society,' credit was given in the most explicit manner.

2. Of a specific fact mentioned in the following passage of his article (p. 69, footnote):

"To cite a case, besides those pointed out by Professor Small * * * Appendix D in my book may be referred to as putting in my way certain things that Professor Giddings puts in his own way in the Science article. Even certain of my terms (as Professor Caldwell also notices), such as 'socius,' 'organic' and 'reflective' sympathy, are used with no intimation of their origin.

'My terms,' Professor Baldwin calls 'socius,' 'organic' and 'reflective sympathy.' We do not suppose that he claims to have coined the word 'socius,' while the specific concept to which Professor Giddings has attached it, if we understand his language, he repudiates. The terms 'organic' and 'reflective' sympathy might conceivably be claimed as inventions in technical nomenclature. But on page 220 of Professor Baldwin's 'Social and Ethical Interpretations' we find the following quit claim:

"Psychologists are generally agreed in finding a distinction necessary between 'organic' and 'reflective' sympathy, similar to the distinction which has been made in considering modesty."

But terms are, of course, minor matters. Let us turn at once to the pure essence of Appendix D. Here it is:

"Whenever the situation depicted by Adam Smith's 'Illustration' was realized—cases involving the sight of both an aggressor and an aggressee with their respective claims upon the onlooker B for sympathy—the creature whose shape, movements, postures, cries, etc., *were like those of B* would be the one which would supply B's copy-system and the one with which his cooperations would arise; that is *the animal of the same kind.* So subjective sympathy would at once be a 'consciousness of kind' and the objective reactions would be indicative of 'kind.'"

The quality of Professor Giddings' dishonesty is now revealed. In a review of Professor Baldwin's book Professor Giddings has put in 'his way' certain things that Professor Baldwin had put in 'his way' in Appendix D, and Professor Baldwin's way—in Appendix D—consists in putting quotation marks about Giddings' way.

In conclusion I would repeat with Professor Small 'there is glory enough to go round.' This means that it is not necessary to vilify other scientists' efforts and work in order to raise the value of one's own contributions. If Professor Baldwin would only remember what he owes to M. Tarde he would certainly hesitate to accuse others of plagiarism.

NEW YORK CITY. GUSTAVO TOSTI.

CARNEGIE INSTITUTION.

THE Advisory Committee in Astronomy will be glad to receive information or suggestions, regarding investigations in astronomy which should be aided by the Carnegie Institution. It is advisable that applications should be made as soon as possible. They may be addressed to the Chairman of the Committee, Cambridge, Mass.

EDWARD C. PICKERING, *Chairman.*
LEWIS BOSS.
GEORGE E. HALE, *Secretary.*
S. P. LANGLEY.
SIMON NEWCOMB.

CAMBRIDGE, March 29, 1902.

SHORTER ARTICLES.

DISCHARGE FROM HOT PLATINUM WIRES.

DURING the past year I have been investigating the discharge from a hot platinum wire, and the results of this work may, perhaps, be of interest to others. An article has been recently published by Rutherford* on the same subject, in which he determined the velocity of the positive ions and showed that at higher temperatures their average velocity was less than at lower. My own work was intended to compare the velocities of the positive and negative ions and to explain as far as possible the decrease in the velocity at higher temperatures.

By a method similar to one which I had previously used in studying the discharge from a flame† it was shown that the average velocity of the positive ions is greater than that of the negative. By a method similar to one used by Zeleny‡ it was shown that the most rapidly moving positive ions have a greater velocity than the most rapidly moving negative ones. By a modification of this method it was shown that the most slowly moving positive ions given off at lower temperature move comparatively rapidly, but that at higher temperatures some are sent off which

* SCIENCE, 14, 590, and *Phys. Rev.*, 13, 321.
† *Phys. Rev.*, 12, 65.
‡ *Phil. Trans. Roy. Soc. Lond.*, 195, 193.

are fully as slow as any of the negative ones.

At higher temperatures the air is ionized to more than molecular distances from the wire.

When the air was enclosed within a tube the rate of discharge became very small. Apparently particles are driven off from the wire at the higher temperatures which are suspended in the air within the tube. These collect on the ions and greatly retard their velocity. These particles do not aid in the discharge, but materially diminish it. Their presence may also be shown by their acting as nuclei in the condensation of water vapor.

These particles are found to be attracted more by the negative ions drawn from a flame than by the positive. It is, therefore, probable that they cause the negative ions in the discharge from the wires to have a smaller velocity than the positive.

Their presence is also shown when the wire is heated in hydrogen, although to a smaller extent. It therefore seems probable that they are particles of platinum, and not of an oxide of platinum.

When the wire is first heated in a vacuum, the discharge is much larger than at any time afterwards. Heating the wire in hydrogen largely restores to it the power of producing discharge. At least some of the discharge would therefore appear to be caused by occluded hydrogen.

The rate of discharge in a vacuum is much larger than in air, but it was found to be impracticable to find the velocity of the ions in a vacuum.

A complete account of the work will be given soon in the *Physical Review*.

C. D. Child.

PALEONTOLOGICAL NOTES.

NORTH AMERICAN ELEPHANTIDS.

Any one who has had occasion to study either the elephants or mastodons of North America needs not to be told that the species of each are very indefinitely known and, for the most part, very imperfectly characterized. Most of the species are based on teeth, one or two on a single tooth, or at the best the description includes fragments of the jaw. Specimens which have been gradually accumulating in the U. S. National Museum make it possible to at least commence the revision of the species of our elephants, while the material that has been gathered by the field parties of the American Museum of Natural History will throw much more light on the subject.

Of true elephants there appear to be three good species, *Elephas primigenius*, *E. columbi* and *E. imperator*. The first-named, the northern mammoth, a species of moderate size, having teeth with narrow enamel bands, seems to have ranged from Alaska southeasterly to about the latitude of Washington, D. C.

A line drawn from Washington to St. Louis and thence northwestward to Victoria, B. C., would roughly mark the southern boundary of its habitat. To the south of this line, extending to Florida and to the city of Mexico, is found *Elephas columbi*, a much larger animal on the average than the northern species, having teeth with coarser enamel bands. There seems to be an overlapping of the two species, especially in the northwestern United States, as noted by Professor Cope, and along this line it is difficult at times, if not impossible, to tell from which of the two species individual teeth have come. Fully grown examples of this species must have attained a height of thirteen feet.

Elephas imperator was based by Leidy on an imperfect upper molar from the valley of the Niobrara distinguished by its great size and extreme coarseness of structure. This specimen long remained unique and was finally considered by Leidy to be the same as *E. americanus* or, more correctly, *E. columbi*, since the former name is unusable, being a synonym. Last fall, however, Mr. W. H. Holmes obtained in Indian Territory a considerable number of teeth of both *Elephas* and *Mastodon* from the same spot, comprising molars of *M. americanus*, *E. columbi* and some referable to Leidy's *E. imperator*. Teeth of this species may be distinguished from similar teeth of *E. columbi* by their coarse structure, the large amount of cement and the small number of enamel plates. Thus an upper molar of *E. imperator* has 17 cross ridges and one of *E. columbi* 21 or 22, while the number of ridges in the lower molars are respectively 18 and 22, this last being an estimate owing to the lack of a perfect specimen for comparison. In each case the molars of *E. columbi* are smaller. Thus Leidy's species may be considered as definitely established.

The mastodons are, as species go, in a badly mixed condition, and even the status of the abundant and widely distributed *Mastodon americanus* is by no means so well defined as one could wish. The last molar of this species varies enormously not only in size, but in proportions and character of the enamel, and while the typical last molar has four cross crests and a heel, there may be four cross crests only, or five cross crests and a heel. Moreover, while the enamel is usually quite smooth, it is often more or less rugose, in some instances being decidedly wrinkled, and *M. rugosidens* of Leidy is undoubtedly based upon a tooth of this character. A fine series of teeth obtained by Mr. W. H. Holmes at Afton, Ind. Terr., shows the great range of variation in the teeth of *M. americanus*.

M. shepardi, once called *obscurus*, from California, is a good species, characterized by a small narrow last molar and by the partial interruption of the valleys on one side. The true *Mastodon obscurus* is a species founded by Leidy on an imperfect last molar from North Carolina, described and figured on plate XXVII., figure 16, of the Extinct Mammalian Fauna of Dakota and Nebraska. This species is so far definitely known from our eastern coast from Florida to Maryland, and the specimens described as *M. floridanus* must be known as *M. obscurus*. The writer pleads guilty to having overlooked this when editing Dr. Leidy's posthumous paper on fossil vertebrates from the Alachua Clays. It is probable that *M. serridens* of Cope is a slightly aberrant fifth molar of *M. obscurus*, although it was decided otherwise in the memoir just referred to. Dr. Leidy was perhaps overcautious in making new species, and described no less than three mastodons under the name of *obscurus*. As an offset to this it may be said that there is reason to believe that Professor Cope went to the opposite extreme of describing one species under three names.

Mastodon mirificus, with a last molar having six much-wrinkled cross crests, is another well-defined species, but there are several others that are not at present well defined. Among these is *M. proavus* of Cope, which he doubtfully separated from *M. angustidens*, and may prove to be the same as *M. obscurus* (=*floridanus*) of Leidy. The writer has never seen a tooth of mastodon from an American locality that was not readily distinguishable from the European *M. angustidens*, and he ventures to doubt the occurrence of this species in North America.

M. productus Cope is another dubious species and so is *M. tropicus*, whose teeth as figured by Cope are indistinguishable from those of *M. obscurus*, while the figure of *M. proavus* strongly suggests the true *M. shepardi*. That one tooth has one more cross crest than the other and is more pointed at the heel means little, as just such differences are known to exist in the last molars of *M. americanus*, while the last molars of various mastodons appear to be exceedingly variable.

The identification of the species of mastodons from scattered teeth is, if not impossible, at least extremely difficult, while the attempt to identify species from figures is equally unsatisfactory. Another question on which light is needed is whether the presence of lower tusks and a long symphysis to the lower jaw is a specific or sexual character, or whether it may not be specific in some cases and merely indicative of sex in others? There are certainly specimens of mastodon jaws with and without tusks whose molars are indistinguishable. It is to be hoped that the time is not far distant when we may have sufficient good material to place our species of mastodons on a satisfactory basis.

F. A. L.

CURRENT NOTES ON METEOROLOGY.

THE DUST STORM OF MARCH 9–12, 1901.

THE remarkable fall of dust which occurred over Europe about a year ago has been noted in numerous short articles in various scientific journals, but there has until very recently been no extended report upon it. Hellmann and Meinardus, of the Prussian Meteorological Institute in Berlin, have just issued an elaborate monograph on this subject, with the title 'Der Grosse Staubfall vom 9 bis 12 März, 1901, in Nordafrika, süd und Mitteleuropa (*Abhandl. K. Preuss. Met. Inst.*, II., 1). The region over which the dust fell extended from the desert of southern Algeria north to southern Denmark, *i. e.*, over a distance of more than 25° of latitude. There were dust storms in southern Algeria on March 8–10; and as the dust was carried northward it fell in Italy and Sicily on March 10; over the eastern Alps on the night of March 10–11; in central Germany on the forenoon of the 11th; in northwestern Germany on the afternoon and evening of the 11th and in southern Denmark on the night of the 11th–12th. In Algeria and Tunis the fall was of dust; in Italy there was a fall of dust during a dry stormy sirocco, and rain heavily charged with dust also fell. In Austria-Hungary and farther north the phenomenon was everywhere associated with some form of precipitation (rain, snow, frozen rain, etc.). The amount of dust which fell to the ground decreased from south to north. Microscopical examinations of the deposit collected in various places make it plain that the dust was of terrestrial origin—an æolian deposit resulting from the disintegration of rocks in a desert region. The particles became finer and finer with increasing distance from their source in southern Algeria, and there was noted a decrease in the percentage of quartz from south to north. The northward progression of the dust-fall was associated with the advance of a barometric depression from Tunis in a north-northeast direction to the southern shore of the Baltic Sea, as shown on the daily weather maps, and the pressures at an altitude of 2,500 m. above sea level likewise indicate the presence of a southerly current from Tunis to central Germany. The velocity of this upper current was found to be 70 km. an hour, and the dust-fall itself also progressed northward at the same rate.

The report of Hellmann and Meinardus is illustrated by means of several charts showing the pressures at sea level and at 2,500 m.; the distribution of the dust over Europe; the distribution of precipitation on March 12, at 7 A.M., and the distribution of temperature on March 11 and 12. 'Der Grosse Staubfall' will prove of special interest to geologists and to geographers, as well as to the meteorologists for whom it was primarily written.

METEOROLOGICAL CHART OF THE GREAT LAKES.

The 'Meteorological Chart of the Great Lakes, Summary for the Season of 1901,' by A. J. Henry and N. B. Conger (U. S. Weather Bureau), presents a number of interesting facts concerning the meteorology of these important bodies of water. The navigation season of 1901 brought a record of 37 total losses of vessels from weather conditions, and 11 from other causes. In addition, 140 vessels were more or less damaged by weather conditions, and of these, 34 cases were due directly to fog. The total number of lives lost through stormy weather was 90. Monthly and annual normal fog charts are published with the present bulletin, embodying the results of four years of fog observations. More fog is encountered on Lake Superior than elsewhere, and the conditions of fog formation are better understood there. On Lake Michigan some of the fogs form in the summer a short distance out from shore during early morning, and dissolve under the increasing warmth of the sun's rays. The early morning land and lake breezes often cause banks of fog to form, sometimes as low-lying fog, and at other times as dense banks, with frequent openings of clear weather. In autumn, when cyclones move in from the southwest, a blanket of fog appears, and may last one, two or three days, with only an occasional clearing.

THE SEISMOGRAPH AS A SENSITIVE BAROMETER.

In a recent number of the *Quarterly Journal of the Royal Meteorological Society* (Vol. XXVII., 1901, 293–298) there is a paper on 'The Seismograph as a Sensitive Barometer,' by Mr. F. Napier Denison, of Victoria, B. C.

A Milne seismograph was installed in 1898 at the Meteorological Office, Victoria, and the author has since that time compared its movements with the changes of atmospheric pressure recorded by his aerograph. He finds that when the barometric pressure is high over the Pacific slope from British Columbia southward to California, while off the Pacific coast the barometer is comparatively low, the horizontal pendulum of the seismograph tends to move towards the eastward. When an extensive storm area is approaching from the westward, and often eighteen to twenty-four hours before the local barometer begins to fall, the pendulum of the seismograph swings steadily to the eastward, and in the event of a well-marked high area following, the pendulum will begin to swing towards the westward before it is possible to ascertain this area's position on the current weather charts.

R. DEC. WARD.

HARVARD UNIVERSITY.

SCIENTIFIC NOTES AND NEWS.

THE National Academy of Sciences will hold its annual stated session at Washington, beginning on April 15.

PROFESSOR F. B. CROCKER has been elected chairman of the executive committee to arrange for the reception in honor of Lord Kelvin, which will be given at Columbia University on the evening of April 21.

THE University of Wales will confer its doctorate of science on Lord Kelvin, Lord Lister and Mr. Alfred Russel Wallace.

M. YERMOLOFF has been elected a correspondent of the Paris Academy of Sciences in the section of agriculture, in the room of the late Sir John Bennet Lawes. M. Baillaud has been elected correspondent in the section of astronomy.

DR. EWALD HERING, professor of physiology in the Medical School at Leipzig, has been elected a corresponding member of the Munich Academy of Sciences.

AT the annual general meeting of the Geological Society of London, on February 21, the president, Mr. J. J. H. Teall, F.R.S., presented the balance of the proceeds of the Lyell Geological Fund to Dr. Wheelton Hind, F.R.C.S., of Stoke-on-Trent, stating that the council of the Society had made the award as a mark of their appreciation of his enthusiastic labors among the carboniferous rocks of this country.

DR. THEODORE PAUL, professor of chemistry in the University at Tübingen, has been called to the directorship of the Imperial Board of Health at Berlin.

M. SAVORGNAN DE BRAZZA, the Italian explorer in the service of the French Government, has been granted a pension of 10,000 francs.

DR. S. WEIR MITCHELL, who has for over thirty years been associated with the Philadelphia Orthopedic Hospital and Infirmary for Nervous Diseases, has resigned as senior physician, but remains as one of the consultants. Dr. John K. Mitchell has been elected to the vacancy caused by his father's withdrawal.

IT is said that the Hon. Andrew D. White will retire from the ambassadorship to Germany in November.

A COMMITTEE has been formed, under the presidency of Professor von Zittel, for the erection in Munich of a memorial of the late Professor Max von Pettenkofer.

PROFESSOR ALBERT RIPLEY LEEDS, since 1871 professor of chemistry in the Stevens Institute of Technology, died on March 14 at the age of fifty-eight years.

DR. JOHANNES CHRISTOPH KLINGE, head botanist of the Botanical Gardens at St. Petersburg, has died at the age of fifty-one years.

THE death is announced from St. Petersburg of Major-General Pewzoff, known for his explorations in Central Asia, Mongolia and Tibet.

AT a meeting of chemistry teachers held at the Hotel Albert, N. Y., March 20, the Chemistry Teachers' Club was organized. A constitution was adopted, and the following officers were elected: A. C. Hale, *President;* R. H. Fuller, *Vice-President;* A. L. Arey, *Treasurer;* M. D. Sohon (Peter Cooper High School), *Secretary.*

After paying all the expenses of the last international medical congress, a surplus of about 40,000 francs is left. The committee expect to apply this sum as an endowment of a triennial prize to be awarded at future congresses.

Lord Walsingham has given to the British Museum (Natural History) his collection of butterflies and moths. This collection of microlepidoptera contains over 200,000 specimens, and is probably the largest and most valuable in the world. It includes the Zeller, Hoffman, Christoph and other collections, and contains many type specimens. Lord Walsingham has himself published numerous monographs on the microlepidoptera.

The University of Cincinnati has ordered for its observatory a refracting telescope, with an objective of 16 inches, from the Alvan Clark & Sons Corporation. The observatory at Cincinnati, established in 1842, is one of the oldest in the country, and has during the last twenty years been under the direction of Professor J. G. Porter.

The magnetic observatory at Nice was compelled to remove to Mount Mounier, owing to interference by the electric trolley car system, and is suing the company for $20,000, the cost of removal.

Commissioner George M. Bowers has selected a plot of thirty acres of land near Tupelo, Miss., for a new Government fish hatchery.

Professor C. B. Davenport and Dr. H. C. Cowles, of the University of Chicago; Professor W. S. Leathers, of the University of Mississippi, and a number of graduate students of the University of Chicago visited Mississippi Sound from March 15 to 31. Making its headquarters at Biloxi, Miss., the party worked on the mainland on Deer, Ship, Cat, Horn and Chandeleur Islands and in the Sound. Special studies in ecology, variation and geographical distribution were made.

The following are among the lecture arrangements at the Royal Institution, after Easter: Dr. Allan Macfadyen, three lectures on 'Recent Methods and Results in Biological Inquiry'; Professor Karl Pearson, three lectures on the 'Laws of Heredity, with Special Reference to Man' (the Tyndall lectures); Professor Dewar, three lectures on the 'Oxygen Group of Elements'; Dr. A. Smith Woodward, three lectures on 'Recent Geological Discoveries.' The Friday evening meetings will begin on April 11, when Professor Dewar will deliver a discourse on 'Problems of the Atmosphere.' Succeeding Friday evening discourses will be delivered by Sir John H. A. Macdonald, Dr. J. Mackenzie Davidson, Sir Robert Ball, Sir Benjamin Baker, Professor A. E. Tutton and others.

Dr. L. A. Bauer will give the following illustrated series of lectures on 'Terrestrial Magnetism' at the Johns Hopkins University from 5 to 6 P.M.:

April 28—'The Principal Phenomena of the Earth's Magnetism.'

April 29—'The Instruments and Methods of Magnetic Surveys.'

April 30—'The Objects and Results of Magnetic Surveys.'

May 1—'The Present Status of the Theory of the Earth's Magnetism.'

The annual meeting of the German Public Health Association will be held this year in Munich from September 17 to 20. The following questions are proposed for discussion: (1) The Hygienic Supervision of Watercourses; (2) Town and Country in their Sanitary Relations and the Sanitation of Rural Districts; (3) Damp Dwellings: Cause, Influence on Health, and Measures for Amelioration; (4) Influence of Quackery on the Health and Life of the Population; (5) The Baking Trade from a Hygienic Standpoint in regard both to Trade and the Consumer.

The Peary Arctic Club's steam barque *Windward* has arrived at New York from Brigus, N. F., where it has been wintering since its return from the Arctic last September. The vessel is to have new engines and boilers installed. It will return to the Arctic regions this summer for Lieutenant Peary.

The London *Times* prints some details regarding the French hydrographic expedition to Indo-China under Lieutenant Hevond. It has begun its labors in the Siamese Peninsula by preparing maps of the bay of Kampong Som and the gulf of Ha Tien. On the completion of this work the ship will return to the eastern coast of Indo-China, where it will remain a month, in order to give the mission time to verify the plans of the mouths of the Mekong. The expedition will then carefully reconnoitre the whole coast of Anam, a work the duration of which it is impossible to estimate, and will subsequently spend several months in Tongking. The rest of the time will be devoted to verifying the results previously reached. Besides its work of preparing maps, the expedition will aim at gathering all general geographical information of interest.

THE House committee on interstate and foreign commerce has voted to report the Hepburn Pure-Food bill to prevent the adulteration, misbranding, and imitation of foods, beverages, drugs, etc., and regulating interstate traffic in such goods. The bill was framed by the National Pure-Food Congress.

THE bill appropriating $10,000 for experimenting on the destruction of mosquitoes in New Jersey has been defeated in the senate by a vote of 8 to 10.

WE learn from the *British Medical Journal* that it is reported that Professor Emil v. Behring (Marburg) will give the amount of the Nobel prize recently awarded him ($40,000) to the Prussian State for the permanent endowment of the Institute of Experimental Therapeutics founded by him in the University of Marburg. The gift is to be devoted to the prosecution on a large scale of the researches on serum initiated by Professor Behring. The fact may appropriately be recalled that several years ago Professor von Behring gave the half of a French prize awarded to him, equivalent to a sum of $5,000, in furtherance of serum research.

THE report of progress of stream measurements for the calendar year 1899, by Mr. F. H. Newell, with the two accompanying papers noted below, has been issued as Part IV. of the Twenty-first Annual Report of the United States Geological Survey. The whole makes a volume of 768 pages, illustrated by 156 plates and 329 figures, including views of rivers and the methods of measuring them, with maps and diagrams of river flow. In the report of progress, tables of maximum, minimum, and mean discharge of streams in various parts of the United States are given, and other data of use to engineers and investors, as well as to the public in general. Following the report of progress of stream measurements is a paper by Mr. N. H. Darton, giving a preliminary description of the geology and resources of the southern half of the Black Hills and adjoining regions in South Dakota and Wyoming. The volume closes with a paper by Mr. Willard D. Johnson on the 'High Plains and their Utilization,' giving a description of the structure of the Great Plains region of western Kansas and adjacent states, and discussing the occurrence of water under ground.

THE London *Times* states that at the last meeting of the council of the Royal Geographical Society it was decided to recommend Sir F. D. Lugard and Major Molesworth Sykes, as recipients of the two Royal medals for the present year. Since 1888 Sir Frederick Lugard has served in tropical Africa, first in Nyasaland, next in what is now British East Africa, then in Uganda, and since then in Ngami Land and in Northern Nigeria, where he now holds the position of high commissioner. During the fourteen years of his African service in countries very little known, he has always devoted much personal attention to the geography of the districts through which he passed, making maps and plans. Major Sykes has been awarded the medal for his journeys in Persia, extending over nine years. Many thousands of square miles of good mapping have been obtained by his political assistance, independently of the large area for the geography of which he has been personally responsible. The other awards of the Society have been made as follows: The Murchison grant to Mr. J. Stanley Gardiner, for his researches in Funafuti Island in the Pacific, and the Maldive Islands in the Indian Ocean; the Gill memorial to Mr. G. G. Chisholm, for the services he has rendered during twenty-five years to geographical education by text-books of various kinds, atlases, and lectures, all of a high standard of value, as well as for his geographical investigations, among other subjects into cataracts and waterfalls, and on the sites of towns; the Back grant to Lieutenant Amdrup, of the Danish navy, for his two voyages of exploration to the east coast of Greenland, during which he surveyed and mapped in detail much of the coast hitherto unknown or imperfectly mapped; the Peek award to Mr. J. P. Thomson, the founder of the Queensland branch of the Australian Geographical Society, who, by his writings and in other ways, has done much to promote the interests of geography in Queensland.

UNIVERSITY AND EDUCATIONAL NEWS.

Harvard University has received three large bequests: $450,000 from the late George Smith, of the class of '53, to be used in erecting three domitories; $100,000 without restriction from the late Robert C. Billings, of Jamaica Plain, and $100,000 from the late Jacob Wheelock, of Worcester, Mass. Mr. Wheelock also bequeathed $100,000 to Clark University, and Mr. Billings bequeathed $100,000 each to the Massachusetts Institute of Technology and the Boston Museum of Fine Arts.

Barnard College, Columbia University, has added $500,000 to its endowment, one half having been given by Mr. John D. Rockefeller and the other half having been collected as a condition of this gift.

By the will of George L. Littlefield, of Providence, Brown University receives $100,000 for the establishment of a chair of American history and the residue of the estate, which, it is said, may amount to $500,000.

By the will of Mrs. S. P. Lees, of New York, Washington and Lee University receives a bequest of $30,000.

Sir William McDonald has given McGill University $20,000 for the purchase of books needed for the research work of students in arts, and has also presented to the physics building a liquid-air plant, and to the zoological department equipment for the teaching of embryology.

The class of '76 at Yale University has established with $5,000 a scholarship, named in honor of President Hadley, who was a member of the class.

Other gifts to educational institutions include $20,000 to Carroll College, in Wisconsin, from Mr. Ralph Vorhees, and $5,000 to the Stevens Institute of Technology from Mr. Alexander C. Humphreys.

We are informed that the Science Hall at the University of Montana was only partially burned on March 14, the loss falling almost entirely upon the engineering department. The foundry, forge room, machine shop and the assay laboratory in chemistry were gutted. The loss is about $6,000, fully insured. The other laboratories were not injured. The burned portion will be immediately rebuilt. The origin of the fire is unknown.

The troubles in the Russian universities and other institutions of learning seem to be very serious. It is said that the University of St. Petersburg will not be open until the autumn, and perhaps not then. In a technical school at Plock the students set fire to the building and attempted to lynch the professors. About one hundred students of Moscow University have been banished to Siberia and about 500 have been imprisoned.

The Carnegie Trust of the Universities of Scotland has prepared its first report. No appropriations have as yet been made for research or the improvement of the facilities of the universities. But in accordance with Mr. Carnegie's wishes, the fees of a large number of students have been paid, the number at each of the four universities and the amount of the fees being as follows: St. Andrew's, 268 students, class fees, £2,452 16s.; Glasgow, 828 students, class fees, £7,672 13s. 6d.; Aberdeen, 473 students, class fees, £3,806 1s. 6d.; Edinburgh, 872 students, class fees, £9,010 5s. 6d.

Miss Eleanor Marie Nast has been awarded by the Woman's College of Baltimore a foreign fellowship in biology.

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, APRIL 11, 1902.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*KNOW, THEN, THYSELF.**

LONG ago, as history measures time, when our planet was regarded as a flat disk girt by an unknown sea, and heaven was no farther away than the fair summit of Mount Olympus; when learning centered about the eastern curve of the Mediterranean, and a knowledge of music, mathematics and philosophy constituted a liberal education, a master mind emphasized the seemingly simple precept, 'Know thyself.'

Centuries later, when the disk had rounded into a sphere; when Jehovah had superseded Jove; when civilization had become continental; when the classics, modern languages and literature had been added to the list of scholarly pursuits, a keen little Englishman echoed the injunction of the ancient Greek.

And to-day, when scientific research has extended beyond the confines of the habitable portion of the earth, invaded the depths of the sea, explored the uttermost heights of the atmosphere and mapped the heavens; when God is worshipped as a spirit and ever more reverently as we begin to comprehend the marvels of his creation; when the making of many books has given this knowledge entrance through every door open to receive it, how much more reason have we than had Alexander Pope to re-

* Address of President of American Folk-lore Society at annual meeting, Chicago, January 1, 1902.

echo the advice of the sage of old, 'Know thyself.'

Man may boast that he has conquered a universe, but what does he know about his own nature? He began to study it but a little more than a generation ago, when the publication of the 'Origin of Species' and the confirmation of the conclusions of Boucher de Perthes rendered possible the organization of the science of man.

Instead of a few individual writers and an occasional investigator there is now a well-trained corps of anthropologists. Active national societies have been formed, costly laboratories are maintained, and excellent journals are published. The science is taught in the leading universities of most civilized countries: in the United States some degree of instruction in it is offered in thirty colleges. It has seemed to me worth while to set forth my reasons for believing that anthropology should be taught in every college in America, both because of the information it imparts and the discipline it gives.

As a branch of education, anthropology has passed the pioneer period. In some of our older institutions, where instruction in it has been given for more than ten years, the number of instructors and students is continuously increasing. Always offered as an elective, anthropology has thus demonstrated its ability to win its way.

As an objection to the introduction of this new science it is sometimes said that college curricula are already crowded. But with the rapidly extending elective system the number of courses offered far exceeds the time limit of any individual. At Harvard, for example, the undergraduate might study one hundred years before obtaining his bachelor's degree if he took all the courses open to him. I presume that the authorities of our universities of a hundred and fifty years ago would have considered their curricula threatened by an appalling congestion if to the subjects of that time had been added simply the increase of courses due to the present status of knowledge in those branches. And yet, besides all these, additional departments—electricity, biology, psychology—have been admitted, not only enriching the schedule of studies, but winning prominent rank therein. Similarly, anthropology, 'the crown and completion' of the sciences, is assuming its rightful place; and I shall endeavor to show why it may be added with special advantage to even a crowded curriculum.

Since anthropology has become clearly defined we hear fewer protests that it embraces too much. Its very comprehensiveness is a virtue; for thereby it is rendered suitable to serve as a framework for all other knowledge whatsoever, a symmetrical framework, lacking which the student but too often builds a series of mental water-tight compartments, so to say, that give no unity or harmony to the intellectual edifice.

Mathematics, for example, though a discipline study based upon necessary reasoning and thus perhaps the most remote from anthropology, nevertheless finds its appropriate place in this ideal educational structure. The anthropologic student learns that among some peoples the mastery of the number concept does not extend beyond the ability to count two or three; that all grades of mathematical comprehension exist from this primitive condition up to our own denary system. He learns that culture may be most profoundly influenced by the reaction of the number concept upon human thought. The basic number may determine the number of gods that are selected to rule; through the calendar it influences agriculture, and, indeed, most of the industrial arts; it affects the pleasures and religious ceremonies of the people. Wherefore I maintain that the addition of the 'human touch' to mathematics gives new meaning to the limited portion of the science with which the average student is acquainted.

In the case of geology the relation to anthropology is more obvious. With the general outlines of geology, the earth building processes, the sequence of strata, and the like, the student is familiar before he takes up the study of anthropology. Passing over the rapidly increasing importance of the economic uses of geologic materials from mine and quarry, we observe that the later geologic periods are of supreme interest in the discussion of the great problems of the time and place of man's origin. Back to the confines of the tertiary we have traced the remains of man and his handiwork, and beyond that barrier we are constantly hoping to pass. Therefore, at each new archeologic discovery the question of geologic age must be answered. After these primal problems come those of the distribution of mankind during the glacial and other cosmic changes. At other points in geology the 'human relation' is likewise established, and without it the allied sciences, geography and meteorology, would be poor indeed.

Permit me to cite one more example, drawn, not from the sciences, but from beliefs. During his course in anthropology the student receives instruction in the so-called 'science of religion,' studying it wholly as a product of human thought or imagination. It is a revelation to him to discover the vital part religion has played in the history of the human race. He learns that religion dictates to millions of his fellow creatures what they shall eat and drink, what they shall wear, how they shall work and how they shall play, what they shall think about, and some things about which they may not even think. Says Brinton of the savage, "From birth to death, but especially during adult years, his daily actions are governed by ceremonial laws of the severest, often the most irksome and painful, character. He has no independent action or code of conduct, and is a very slave to the conditions which such laws create." Not only among savages does this intimate connection between religion and all other elements of culture manifest itself, but also in all other grades of development, in all times and places. He must have breadth of view who realizes the significance of it. The theological student, however liberal, views but one side; the art student sees little more than the influence of religion upon painting or architecture or music; the sociologist deals primarily with Caucasian culture; the anthropologist alone investigates religion impartially in relation to other phases of thought.

Furthermore, the erection of this framework brings before the attention of the student the rooms that are incomplete and vacant, so that he may set about furnishing them. With this guidance he will study modern geography, with its complete survey of environment and life; comparative religion, with its breadth of view; the fine arts, as the highest expression of universal feeling; history which he will approach with a correct sense of proportions and time relations. For he will see that the adoption of the first articulate word by man, as distinguished from the mere animal cry of his ancestors, was an event of infinitely greater importance than the foundation of the Roman Empire; that the discovery of the art of kindling fire was vastly more significant in history than the battle of Tours.

Modern anthropology does not formulate theories from travelers' tales nor indulge in metaphysical speculations. It proceeds to its conclusions by the scientific method of direct observation and experiment, a method that is obtaining so much popularity that most students desire some acquaintance with it. By proper training in any of the natural sciences this knowledge may be acquired, but it frequently happens that students having no taste for these branches will not take them under the elective system. Thus they may be graduated with an excellent store of linguistic, literary or mathematical information, and yet be sadly deficient in the power of observation and of correct inference, important requisites for success in this workaday world. To such students anthropology opens a new field. He who may abhor the smell of zoological specimens and the sight of laboratory dissections will, perhaps, take kindly to the examination of fictile objects, or textiles, or the various other art products that we study to determine the cultural status of this or that group of men, or for the purpose of tracing the course of industrial or æsthetic development. He who may be indifferent to the wonders revealed by the lens of the botanist may engage with enthusiasm in research relating to the music, mythology or ceremonies of alien peoples. He whose interest is not held by the marvelous story of geology fixed in lifeless stone may be zealous in the study of living humanity.

Among his fellows the anthropologist finds abundant opportunity for cultivating his powers of observation. After studying the problems of heredity, miscegenation, degeneracy, and the like, it becomes an instinct with him to note the color of hair and eyes, the shape of the head and face, and other individual peculiarities of those around him. A friend tells me that he relieves the tedium of a long examination of which he may have charge by tabulating statistics concerning the busy writers before him; how many are left-handed, part their hair in the middle, wear glasses, are blonds or brunettes and the like. Here it is little more than a pastime, but it illustrates the manner in which the habit of observation is fixed.

In the field the anthropologic investigator quickly discovers that to record accurately requires the keenest watchfulness. Let us suppose that we are witnessing the annual festival of the Jicarilla Apaches. The event is the relay race. The runners are marching in column through the surging mass of spectators. Drums are beating, rifles and revolvers are fired, shouts and cries add to the confusion. What is the signal that causes the column to divide? Why do all march to one goal and then half of them march back to the other? Soon the crack of the starter's pistol sends the best runner of each of the two groups down the course on the first relay. The excitement is intense. The walls of the narrow lane down which the brown forms are flitting yield to the pressure from without and threaten to collapse. The observer struggles to obtain a position near the goal. Does the winner touch his successor of the next relay? Does he hand him any object to carry? What is the purpose of these branches of cottonwood that are moved up and down the line? What is the meaning of the tufts of down that are added to the scant attire of the runners? Why are they cooled by spraying their backs from the mouths of their attendants? What are the methods of imparting speed resorted to by the opposing factions? For half an hour the observer hurries from point to point with camera and pencil in hand, and then suddenly the uproar becomes deafening. The race is ended. Offerings of bread, grapes and other fruits from the distant Rio Grande—even watermelons—are thrown from the crowd to the victors. A dozen observers are needed now to complete the account. Indeed, some measure of ubiquity is often longed for by the field-worker. He has every incentive to become proficient in quickness and accuracy of observation.

Again, the student may be so fortunate

as to witness a Maricopa medicine dance. The shaman is in doubt as to the nature of the disease; he must consult the dead for guidance in treatment of it. Followed by his awe stricken friends he approaches a grave, but not too closely, and calls to the resident spirit. Out of the darkness of the night come ghostly whispers in reply. The medicine man grows more confident and emphatic; his followers shrink farther back. To them the dialogue is conclusive evidence of the power of the shaman. To the observer it presents an opportunity for the detection of fraud. Is he clever enough to discover the identity of the confederate? Can he see without seeming to do so?

The nature-quickened keenness of observation of those whom the field investigator studies affords him an example wherefrom he must needs profit. In no other science is the object of research at once an example and also laboratory material. Again and again I have been impressed by the degree of perfection in observation manifested by Indian hunters in all parts of America. Old Peter, the Assiniboine, for example, with whom I hunted big horn in British Columbia, taught me as much about observing as any college professor ever did. Of course I appreciated the fact that his livelihood depended upon the cultivation of this trait, and it was not surprising that he should manifest proficiency in that one line when practically all others were excluded. Peter led the way into the mountains through passes yet choked with the late snows of winter, riding an old cayuse whose speed was not in the least accelerated by the tattoo of Peter's heels on its ribs. A band of green mosquito netting kept Peter's hat-rim against his ears on cold days, and served to protect his eyes on bright ones. But my attention was soon drawn from his attire to the skill with which he read the half obliterated signs. I could see the tracks as well as he, but I could not follow a single one through a maze as complicated, apparently, as the crowded street through which the dog trails his master with unerring swiftness.

Contrast with Peter's keenness the lack of it exhibited by the Gila freighter, who had made a dozen trips to Tempe, and yet wagered his team that the butte that overlooks the town was on the left as one approaches the place. There are no hills to confuse one's memory within twenty miles along that road, so that he had no excuse to offer, no word to say, when he found the butte on his right as he entered Tempe. He simply left the team and wagon to his more observing companion and walked home.

Incidentally, field research enables the student to travel, and thus add to his resources for happiness throughout life. For it is not alone the viewing of new scenes and new peoples that gives him pleasure, but there is the more lasting enjoyment resulting from the addition of new territory to his literary domain. For example, it is well known that he who visits the realm of arctic frost is ever tempted to return. He also finds the keenest pleasure in reading of the experiences of others in that region of infinite vastness. After the lapse of ten years I feel as deep an interest in that 'Land of Desolation and Death' as when I left it. Again, those who know the great arid Southwest find in its tragic history and in the writings of its pioneer anthropologists a source of perennial pleasure. He who has felt the spell of the desert has added a priceless treasure to his experience. He can sympathize with the belief of the desert dwellers that the wraith-like *remolinos* sending their columns of sand toward the bluest of heavens are not miniature whirlwinds, but spirits of air; that the pillars and other strangely eroded forms of sandstone are the figures of men transfixed there in the early twilight of time; he himself has felt the clutch of the demon of thirst that camps ever close upon the trail.

The student engaged in field research in archeology can usually find but few facts at best from which to reconstruct the history of the past, and those few are often obscurely hidden in the mud of the swamp or the sand of the desert, where a careless blow of the spade may annihilate the record forever. For example, the shape of ancient wooden implements may be known from the mold of clay in which they decayed; but this form may be destroyed by a single stroke. Many old skulls, also, are so fragile when found that after a few minutes' exposure to the air they crumble to dust. Careful treatment may save some of them, but quick and accurate observation is absolutely necessary.

But correct observation is not the sole requirement for success. It suffices to render a man useful and helpful in minor positions, but ere he can become a leader in thought and action he must have the ability to interpret the data accumulated. In other words, he must develop his reasoning powers, and here again anthropology presents her opportunity. In the domain of culture history, particularly in its genesis, he ventures upon so much controversial ground that he must wield his weapons well in order to pass safely through. It was to this opportunity for diversity of opinion, and the innate bellicose tendency of man, that Huxley attributed the growing popularity of the science a quarter of a century ago. I have found that the presentation in the lecture room of the interjectional, gesture, and other theories of language usually leads to the liveliest discussion with the students, discussions that are sometimes adjourned to the home of the instructor. The ascertainable evidence relating to the origin of beliefs gives rise to widely differing inductions. A venerable friend who is preparing a treatise upon religion told me that he had found sixty-two theories accounting for its origin—and I had the pleasure of calling his attention to a sixty-third. In the examination of any considerable portion of that array of arguments, the student must exercise his judgment to discriminate between the plausible and the reasonable. He aims to discover fundamental principles and laws, and to that end his attitude must be, not credulous, but critical. Folk-lore, too has its debatable problems of myth migration, acculturation and relationship. In the arts opportunities for independent reasoning abound; for example, the student may examine the weapons, utensils and ceremonial objects of a tribe, and by comparison and analysis determine the character and course of development of its decorative art. He may study primitive scales of music, and investigate the theories of Darwin, Spencer, Grosse and others accounting for its origin.

The ethnologic study of technology is by no means the least in its power to stimulate thought. The college student all too frequently loses sight of the importance of the part that manual labor plays in the maintenance of civilization, and is usually ignorant of the extent of its contributions to cultural development. It extends the range of his thoughts to learn of the age-long gropings of his forebears in their discovery of the value of a newly fractured flint as a cutting instrument, and their improvement of it until it became a symmetrical blade. He sees a deeper meaning in the simpler industrial activities as he learns that the training of the muscles reacts upon the brain. The savage who binds a rawhide netting around a rough frame for his snowshoes, finds that the untrimmed edges of the wood soon cut through the leather. He makes many pairs, perhaps, before he notices that when he scrapes the surface of the wood the lashing wears longer. He derives a sensation of pleasure, also, from the contact of his hand with the smoothed surface, and this gradually develops a mental pleasure at the sight of well-made frames. His skill in cutting and carving increases with practice, so that decoration of implements and weapons becomes possible, or, as we say, 'the manual concepts react upon the æsthetic mental concepts.'

When the student of anthropologic habit of thought contemplates that wonderful product of this industrial age, the ocean liner, he takes it 'by and large.' His mental vision sees beyond it the long line of less and less ambitious craft that terminate with the floating log propelled by a pole, or with the naked hands. Yet more than this: he sees migratory movements probably initiated by the food quest that required the use of boats to cross, now a river, now an arm of the sea. He sees a resulting development of commercial routes forming a vast network, which even in the earliest historic times was the product of centuries of growth and the interplay of forces ultimately environmental. The vista is a long one, and in viewing the evolution of this single industry the student perceives something of the complexity and grandeur of the laws that have moulded the modern arts. And so, because based upon broad lines, and yet balanced by exhaustive special researches, the science of anthropology develops a sane and wholesome mind.

The inherited proclivity of the Anglo-Saxon to despise all non-Caucasians becomes in the anthropologist a passion for studying them. He knows that his self-assumed superiority has its limitations, that his own ancestors in times geologically recent were tattooed cannibals as primitive in habit as the Digger Indians of the Sierras. He knows that his culture is in a measure due to environment, to the chance that led those early immigrants to a continent whose vast extent of shoreline rendered it immeasurably superior to all others as the home of commerce. His people were surrounded by animals capable of domestication, while the American race, for example, was handicapped by their absence.

Not only does the anthropologist take a more modest view of the virtues of the Caucasian, but he also learns to credit the savage and barbarian with many praiseworthy qualities. He finds that our aborigines are more devout than we, their happy family life most exemplary, their patience and courage under the wrongs of border 'civilization' most admirable. This knowledge induces forebearance and respect. Brought into contact with these and other alien races through field research, the anthropologic student discovers that they can estimate his worth with surprising quickness; they may not have heard of the nebular hypothesis, they may be unacquainted with the units of the metric system, but they can take the measure of a man with a glance.

Anthropology, with ever-widening knowledge of the peoples of earth, promises to make real that dream of the poets, the brotherhood of man; not a relationship based upon sickly sentimentality, but a brotherhood resulting from an understanding of the capacities and limitations of our fellow beings. We shall then have appreciation without adulation, toleration not marred by irresponsible indifference nor by an undue sense of superiority. Anthropology leads to a more charitable attitude toward the diverse philosophies of men, dealing as it does with the basic motives of all systems. It induces religious toleration, 'which,' says our greatest of college presidents, 'is the best fruit of the last four centuries.' And yet, although the sun of enlightenment has absorbed the flood of mediæval religious persecution, we have all seen remnants, noisome pools of intolerance, in localities where the cleansing rays seldom and feebly penetrate. I know of no instrument with a potency equal to that of anthropology for their removal.

The proverbial tendency in the college student toward self-complacency is checked and corrected by a knowledge of the broad lines of cultural development, of the primal principles of all human activities. Vanity cannot thrive in the contemplation of a plan that requires an eternity for its fulfilment. 'Wisdom is before him that hath understanding.'

The somatologist discovers in the human body a record, kept by the vital principle of heredity, of its upward struggle from the simplest animal forms. This living history dates from a past beside which the glacial epoch is but as yesterday, yet it is not vague and indecipherable; it is boldly written. Pages are inscribed in our muscles; others in vein, artery and gland; in the digestive system and the epithelial tracts; and others in that most conservative of tissues—the nervous system. In head, trunk and limbs these functionless 'fossilized structures' abound, not only useless to us now, but positively dangerous, as they frequently become the seat of disease.

In like manner, the folk-lorist finds in the body politic survivals of belief and practice that antedate and supplement written history. Backward they lead through ever simpler social organizations to the primitive period when men walked in the fear of gods innumerable that influenced every waking moment and filled with dread their dreams. Yet farther, and the investigations of the folk-lorist mingle with those of the comparative psychologist along the border line between brute and lowest human. These survivals, also, are a menace to individual welfare, as I doubt not that more than one person will be executed for witchcraft within the boundaries of these United States in this year of grace, 1902. It is not long since a Pima Indian was killed by his fellow villagers in Arizona because he knew how to use a carpenter's spirit-level. With the magic stick he had begun pushing at unheard-of speed the preliminary survey for an irrigating ditch. That night a jury of his peers tried, convicted, and shot this Piman martyr to progress.

Not only the individual, but the tribe or community also, may be injured by the continuance of traditions from a lower cultural stage. 'The power of tradition' is an accepted aphorism. An illustration of the power and possibilities of evil in such a survival is seen in the case of the city of Mexico. Six centuries ago a migrating band of aborigines was led by a myth to select an islet in a stagnant lake as the site of their pueblo, a choice that it is extremely improbable they would otherwise have made. But the eagle with the serpent in his talons alighted on a cactus there, and thus determined the location of Tenochtitlan. The village became a city and throve in material prosperity, but it suffered one serious disadvantage; it was subject to submergence under the waters of the lake, so that protection was sought in a great causeway seven or eight miles in length. Later a drainage canal was begun; as the centuries passed, millions on millions were spent in the work, thousands and hundreds of thousands of peons perished in that ditch. In the mean time, the city of Mexico suffered the odious distinction of having the highest death rate of any capital in the world.

Not alone in its origin, but also in its downfall as the seat of Aztec power, did this city illustrate the effect upon the community of traditional belief. In the golden age of the empire the fair Quetzalcoatl taught the useful arts, and of the lands of Anahuac he formed a paradise. Cotton had not then to be cultivated, but grew wild, ready colored the hue of every dye. The maize plant was of such a size that a single ear was a carrier's load. Melons o'ertopped their owners' heads. Not the favored class alone, but all men possessed palaces of silver and gold. But the adversary came in the form of an old man who roused in Quetzalcoatl a desire to wander to other lands. With his departure the fruit-trees withered and the singing birds took flight. Then arose the belief that he would return, and it was the expectation of his second coming that unnerved the fierce courage of the Aztec warriors before the pale-faced Cortez. Was he the white god of their fathers? Credulity, doubt and dissension hastened their undoing.

For more than a millennium England has been a Christian nation, yet in the museum at Oxford we see images, bristling with rusty nails and needles, which demonstrate the late survival of a belief in sympathetic magic in the rural communities whence these objects came. Within the university itself I secured a desiccated specimen of a familiar vegetable which an officer of one of the colleges had carried for years as a preventive of rheumatism! Neither centuries of enlightenment nor the revolutionary changes of this progressive age have exterminated such beliefs. They even adapt themselves to the new conditions, as in the case of the lady living within the shadow of the walls of Harvard University, who maintains that carbons from arc lamps are a sure preventive of neuralgia!

I am aware that the study of these beliefs sheds light upon the history of the mental development of the race, and is of the highest value in certain theoretic considerations, but I involuntarily think of folk-lore as a study that will influence practically the life of him who engages in it. He learns that much that he has accepted from childhood without thought as truth is mere superstition and error. Not until he has had his attention called to the existence of these survivals does he realize their abundance, or the part they play in the daily lives of those around him. They are by no means confined to the servants' quarters; they are also in his own family, to whatever class or country he may belong. The nature and the prevalence of error are literally brought home to him. We all admire truth and natural law—in the abstract—and seek the widest possible knowledge of them by means of a most admirable educational system. And yet the graduate seldom possesses the power of applying theoretical knowledge to his own individual life. This is not an argument for what is termed 'a practical education,' but an explanation of a condition which I believe can be greatly improved by thorough training in anthropology.

By the comparison of customs and beliefs it was discovered several years ago that striking similarities exist whenever like environmental conditions prevail. It was the discovery of this principle of unity that led anthropologists to seek among the savages and barbarians of to-day an explanation of survivals in the Caucasian group. Hundreds of examples of these 'Ethnographic Parallels' have been observed. One will serve our purpose here. In savagery the functions of priest and physician are combined in the medicine-man. He fits himself for his profession by a rigorous training, and has the utmost faith in his own power to enlist the sympathy of the beneficent gods and to expel the evil ones. Disease he banishes with a formula of magic words, or with ceremonies that are oftentimes elaborate. Upon analysis it is found that the success of the shaman depends upon two elements, the credulity of man, and the power of the sub-conscious mind. The parallel is observed in the medicine-men of that modern cult which numbers hundreds of thousands of otherwise intelligent Americans. Their healers proceed by methods no more rational than those of the aborigines, and in some respects similar to them. Their success depends upon the same two factors. The red shaman calls the headache an evil demon and proceeds to suck it through a tube. The white shaman terms it sin and dispels it by a 'demonstration.'

The student of folk-lore learns of the rise and fall of many an 'occult' belief. As this phase of human experience is intangible and variable, those only who have been instructed concerning the characteristics of thought can profit by an accumulated knowledge.

While anthropology may not be classed as a 'bread and butter' study, it does equip the student who is to become a merchant, physician, attorney, with a practical knowledge of the motives of his competitors and clients. He learns in youth the significance of the folk-saying, 'Human nature is the same the world over.' His interest in the science cannot terminate with the pass-mark of the final college examination, but must be coextensive with his interest in his kind. He will employ it in his vocation and enjoy it as an avocation.

To the aspirant for honors in the diplomatic service, anthropology offers an admirable training. He learns the significance of the racial factor in national welfare; the measure and condition of progress; the principles of ethnologic jurisprudence; and, also, the characteristics of the particular people among whom his duties lead him.

For the legislator, anthropology must become a necessary preparation. America has problems whose solution calls for the widest knowledge of races and cultures. Such knowledge, free from political bias and hereditary prejudice, can best be gained by the study of the science of man. The list of these problems is a formidable one, including Philippine slavery, Mohammedan harems, Tagal insurrections, Spanish-American complications, coolie labor, the negro problem, the Indian question, not to mention the demands for legislation that shall regulate the immigration of Poles, Russian Jews, Italians, Hungarians and others.

Anthropology prepares the law-maker and the jurist for the task of coping with crime. Criminal anthropology has explained the character and causes of criminality and degeneracy, and led to revolutionary changes in the methods of crime prevention. While it is difficult to accept all the claims of the school of which Lombroso is the accomplished master, we must acknowledge our indebtedness to it for the reforms that it has directly or indirectly inaugurated.

For the injurious effects of exclusive specialization, anthropology offers a corrective. It is particularly fatal to narrowness in the teacher, who oftentimes leads young people to specialize in his particular field before they are aware of their own aptitudes and wishes. It forearms the teacher of inferior races, who usually ignores the traditional mental activities of those he would instruct. It induces a more considerate attitude in the missionary who calls the religion of his parishioners mere superstition, and speaks with contempt of their mode of thought, not appreciating the manner of its growth through uncounted centuries of struggle.

These few representative examples but suggest the extent of the utility of the science in the affairs of men. In the training of youth anthropology furnishes a comprehensive outline of human knowledge, showing the relations existing among its several branches, and giving the student a correct sense of the proportion between what he knows and what there is to know. Employing the scientific method, it teaches how to observe. College training in it is continued directly in subsequent experience with the world. The material is ever at hand. Dealing with the vital problems of all epochs, it inculcates breadth of mind and develops the reason. It induces consideration and awakens appreciation of other men and other races. It supplies an available touchstone of truth and error. Wherefore it is that a new and deeper meaning now abides in the words:

"Know, then, thyself; presume not God to scan;
The proper study of mankind is man."

FRANK RUSSELL.

AMERICAN MORPHOLOGICAL SOCIETY.

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Notes on Cyanea Arctica: CHAS. W. HARGITT.

The early cleavage phases are passed while the eggs are still within the gonads or in the complicated folds of the manubrium. A gastrula is formed, following total cleavage, by invagination, and an early closure of the blastopore ensues. The embryo becomes ciliated before its escape from the egg membrane, within which it may be seen slowly rotating. On emergence it is almost spherical but soon assumes the ovoid shape characteristic of the Cœlenterate planula. While details as to the formation of the entoderm are not yet complete they seem in the main to confirm the observations of Hyde, Smith and the recent work of Hein.

The encystment noted by Hyde and McMurrich has been common in the specimens under consideration, though I have been able to show that the process is rather incidental than essential as claimed by McMurrich. It seems wholly conditioned upon the environment; where favorable and natural the process is rare or absent.

The scyphistoma stage of development was attained in variable periods depending again upon conditions. Under favorable conditions it may occur in from eight to ten days, while under other conditions it may not take place within as many weeks. Thus also with the changes involved in strobilization and the release of the ephyræ. Under favorable circumstances they have taken place in the aquarium within a period of eighteen days from the escape of the planula to that of the ephyra.

Stolonization occurs as in *Aurelia,* but much less freely, as does also the origin of buds from the stolons. Budding from the side of the polyp was not observed in *Cyanea,* its small size probably rendering such process difficult.

The entire life history from the egg to the free ephyra was followed in detail with unusually good results in aquaria of varying size from a mere watch glass or petrie dish to jars holding a gallon or more.

Notes on the Cœlenterate Fauna of Woods Holl: CHARLES W. HARGITT.

Inheritance of Color Among Pointers: FRANK E. LUTZ and ELIZABETH B. MEEK.

Dr. Francis Galton ('89) proposed 'briefly and with hesitation' a statistical law of heredity applicable to bisexual descent. Briefly stated, it was that one half the offspring's characteristics are derived from the parents (an equal amount from each), one fourth from the grandparents, one eighth from the great-grandparents, one sixteenth from the great-great-grandparents, and so on. Galton himself ('97) tested this hypothesis by the consideration of a single color characteristic—the conditions of being tricolor or non-tricolor—in

Basset hounds; but with this exception the important law advanced more than a dozen years ago has not, up to this time, received a careful analysis of a large number of pedigrees, of three or more generations.

Our work was carried on with data obtained from the American Kennel Club Stud Books and includes 390 dogs, of the pointer breed, of which 660 parents, 1,367 grandparents, 1,361 great-grandparents and 978 great-great-grandparents are known. Four sets of color characteristics, namely, liver or no liver, black or no black, white or no white, and 'ticked' or not 'ticked,' were considered. By the method used no substitutions were needed to fill the gaps left by unrecorded ancestors of the first four degrees. The results showed an almost perfect harmony, in each instance, between the facts and Galton's law, the greatest real deviation being only 1.1 per cent., while the least was .4 per cent.

Astrosphere and Centrosome in the Fertilization of the Egg of Phascolosoma (P. vulgare and P. Gouldii): J. H. Gerrould.

The Larval Development of Phascolosoma: J. H. Gerrould.

On the Ova of Ophidia: E. L. Mark and C. A. Crowell.

A System of Abbreviations for the Lettering of Anatomical Figures: E. L. Mark.

The Circulatory System of Lamellibranchs: G. A. Drew.

By careful injections, preparations and dissections, the vascular system of the large northern scollop, *Pecten tenuicostatus,* has been found to be extensive and definite. In the mantle, for example, the blood vessels branch repeatedly and form a very fine network that in appearance is much like a capillary plexus. From this plexus the blood is collected directly by vessels that join to form the vein that, in common with the efferent vessels from the gills of the corresponding side, returns the blood to the heart. Inasmuch as some of the coloring matter of the injecting fluid finds its way out of the vessels and into the surrounding tissue, it seems quite possible that the blood may function directly as lymph. Large lacunæ, such as are generally supposed to be present in Lamellibranchs, have not been found. The vessel that supplies the foot is capable of great distention, and offers the same for the protusion of the foot, but the vessel is very definite in shape and is not comparable to a lacuna. The course taken by the blood in its circulation is essentially the same as has been described for other forms, but the vessels seem to be much more finely branched, and the circulatory system much more nearly 'closed' than has generally been supposed to be the case with Lamellibranchs.

On the Anatomy of a Double Monster: H. L. Osborn. (Read by title only.)

A calf born near Minneapolis, Minn., in 1901, and which lived only a few minutes, came to my notice and proved interesting as a nearly complete twin formation. There is a single umbilical opening and cord, there are two functional hind legs and a single anus, but there are two tails and a third hind leg carried in the mid-dorsal line, and projecting backward. Anteriorly there are two complete animals, two heads, thoraces and two anterior abdominal regions completely developed. There is a single abdominal cavity posteriorly, but most of the viscera are double. There are two spinal columns, each sacrum articulates externally with a complete half pelvis, and these meet below, forming a symphysis, and on its opposite side each sacrum articulates with an ilium which meets a very imperfect ischium, so that here the division of the embryonic material has not gone to a finish. The small intestines meet not far from the pylorus and communicate transversely, and a single piece continues thence to the anus, a distance of about seven feet. There is no distinction of small and large intestine, except a sudden enlargement at which two cœca are located (one for each component of the calf). There are two nearly complete circulatory systems but an umbilical artery is lacking from each side (the inner), and the internal iliac veins join and fuse in the middle line. There are two pairs of kidneys, and there are two bladders; one is in front of the other. They communicate at the fundus. The urethras are not developed; the hinder bladder has the urachus open and both bladders discharged by this passage. The ureters are symmetrically related to the two bladders; those of the outer kidneys, one from each body, discharging into the hinder bladder, while those of the two inner bladders communicate with the anterior bladder. There are two pairs of testes; the outer pair had descended, their vasa deferentia communicating with the hinder bladder, while the inner pair are still beside their kidneys and in communication with the anterior bladder.

Notes on the Trematodes of Lake Chautauqua, N. Y.: H. L. Osborn. (Read by title only.)

Studies made in the biological laboratory of the Chautauqua College of Liberal Arts have shown that the adult stage of *Distomum (Microphallus) opacum,* Ward, is of frequent occurrence in the stomachs of the black bass, and its earlier stage in the crayfishes, where, instead of frequenting 'the space in the cephalothorax above the heart and sexual organs' (Ward, *Am. Mic. Soc. Trans.*, XV., p. 79, 1894), it is found invariably in the liver, whose effective area is frequently greatly reduced by the cysts. A second distomid occurs in the stomach of the black bass, though less frequently. It has been seen elsewhere by Wright and Linton and referred by them to *Distomum (Bundera) nodulosum.* It is not, however, identical with the European form and will very likely need to be recognized as a new species. It is characterized by a difference in the lateral lobe of the oral apparatus. Its earlier stages were found abundantly in crayfishes of the lake. They are found in nearly every crayfish examined, and occur encysted in the heart, gonads, muscle and surrounding spaces of that region. Two other species of distomids are frequent in fishes of the lake; one, an undetermined distomid of very minute size, occurs in the nearly digested slimy chyme gathered about the entrance to the small intestine, appearing like numerous minute black elongate specks scattered through the slime, and proving to be sexually mature forms, the black color due to the embryos filling the uterus. This species has not yet been located, and it seems to be not well known. Another little known and possibly new species occurs encysted in round black spots a millimeter in diameter in the skin of the fins and of the body generally, in rock bass and darters. Another distomid, unknown in the adult, was previously reported on from this locality (*Zool. Bull.*, p. 301, 1898) as occurring in *Anodonta plana* and causing the salmon-colored deposit on the inner surface of the valves of the shell. The *Anodontas* also always contain one or more individuals of *Cotylaspis* adhering to the surface of the kidney (*Zool. Bull.*, p. 85, 1898.) An extended article on these is now in course of publication. There is to be found encysted in the liver of the sunfishes a form that has not as yet been sufficiently studied to ascertain more than that it is a *Diplostomum*, or nearly related to it. Further studies of all these forms are now being made.

The Eye of the Common Mole: James Rollin Slonaker.

The eye of the mole lies imbedded in the muscle beneath the skin, where it appears as an inconspicuous dark spot. It is situated well forward on the side of the snout.

The eye is degenerate and is no longer capable of functioning in distinct vision. The most noticeable changes which have occurred are:

1. The great reduction in the size of the eye.

2. The much crowded condition of the retina as a result of the decrease in size of the eye as a whole.

3. The noticeable reduction in the size, or the complete absence of the aqueous and vitreous chambers.

4. The varied modification of the shape and size of the lens. Also the peculiar cell structure of the lens.

All the structures of the normal mammalian eye are present in some form or other.

Two stages have been studied: (1) At birth, (2) the condition found in the adult. Very little difference is seen in these two stages excepting an increase in size.

The eye muscles and the optic nerve are easily traced back to the skull. At birth the nerve presents in its course from the eye to the skull a peculiar arrangement. The course is marked by numerous cells and few or no fibers. At the eye there is a rapid change from this cell condition to the fiber condition of the nerve tract. The fibers have not apparently grown much beyond the limits of the eye. In the adult the fibers can be traced to the skull.

The eye cleft may be seen in cross sections. It is very small and of practically the same diameter in both horizontal and vertical sections through it. It meets the eye at such an angle that it is impossible for rays of light, should any enter, to pass through the eye along the axis of vision.

All the elements of the normal retina are present, but, owing to the much crowded condition, the ganglion cell layer is much increased in thickness.

The lens, which is found in a great variety of shapes and sizes, is composed of peculiar cartilage-like cells with well-defined nuclei. It is therefore incapable of functioning as a normal lens.

It is very doubtful therefore whether the eye of the mole functions in any sense. At the best it can do no more than distinguish between light and darkness.

The Breeding Habits of Certain Fishes: Jacob Reighard.

1. Experimental evidence was offered that the nests of *Amia* are built by the male fish alone. Access to an area of the natural breeding ground was barred by a fyke net, in which fish that attempted to reach the breeding ground were caught and kept living. The males were removed from the net and placed in the natural enclosure behind it; the females were confined in a crate. Twenty-three nests were built by the males and of these only five ever contained eggs. These eggs were apparently all laid by one or two females that had gained access to the enclosure. The remaining eighteen nests were never used and were finally abandoned.

2. It was pointed out that the colors of the male *Amia* are protective in the breeding season. The fins are all colored green in harmony with the surrounding vegetation. The reticulation of the sides is in close imitation of the shadows cast by the interlaced and floating parts of water plants. The tail spot is strikingly like certain refraction images cast on the bottom

by irregularities of the surface of the water. Such images are small black spots, orange or yellow bordered.

3. It was pointed out that in the male of *Eupomotis gibbosus* the colors are much brighter than in the female. The vermicular markings on the cheeks of the male are more brilliant than those of the female; the opercular ear-flap is larger and bordered with scarlet and blue; the ventrals of the male are black, while those of the female are yellow; the dorsal and caudal of the male are much more brilliantly blue than those of the female. In approaching the female, in order to induce her to enter his nest to spawn, the male elevates or puffs out the gill covers so as to display their brilliant markings. At the same time the opercular ear-flaps are erected and the black ventral fins spread out. When in this attitude the male faces the female and it is when seen from the front that his display of color is most brilliant. He assumes a similar attitude when threatening other males. He was never seen to assume this attitude except under the circumstances described, so that the display of color resulting from the attitude must be regarded as a means of expressing the emotions.

The Early History of the Lateral Line and Auditory Anlages in Amia: Cora J. Beckwith. Presented by Jacob Reighard.

No common anlage of the auditory pit and lateral line system, such as has been described in Teleosts by Wilson, was found in *Amia*. The auditory pit was found to arise much earlier than the lateral line system and in the usual way. It is at first imbedded in an elongated mass of mesectoblast proliferated from the neural crest. This mass of mesectoblast, with enclosed auditory pit, bears a considerable resemblance to the common anlage of auditory pit and lateral line system referred to above. It subsequently extends into the adjacent gill arches, where its further history was not followed. The lateral line system makes its appearance at a later stage in the form of several independent ridge-like thickenings of the ectoblast which subsequently fuse. It is at no time connected with the anlage of the auditory pit.

The Vascular System of the Common Squid, Loligo pealii: L. W. Williams.

The knowledge of the histology of the vascular system of decapod mollusks is very incomplete, especially in reference to the extent of the capillary system. In addition to the capillaries, lacunæ have been believed to intervene between the arteries and veins. The extent of the capillary system was determined by injecting the vascular system with Berlin blue, and the lining of the vessels was studied by means of silver impregnations. Both the arterial and branchial hearts seem to lack an endothelium. The branchial heart consists of striated muscle and apparently secretory polygonal cells. The intrinsic muscle of the peristaltically contractile arteries resembles connective tissue. The arteries and veins are connected in all parts of the squid by capillaries. All the vessels are lined by an endothelium. The veins are connected with small end-sinuses which enclose the terminal branches of the arterioles and receive numerous capillaries, some of which arise from the perforating arteriole. The so-called lacunæ which partially enclose the pharynx and eyes are sinuses, since they have endothelial walls and since they intervene between veins, not between veins and arteries.

The wide distribution of the capillary vessels, the presence of an endothelium around every blood-containing cavity except possibly the heart, and the absence of demonstrable lacunæ, all lead to the conclusion that the arterial and venous vessels of the squid are connected by capillaries which form a closed vascular system.

The Branchial Nerves of Amblystoma: G. E. Coghill.

1. There is, in larval *Amblystoma,* a complete series of pre-trematic rami of the ninth and tenth nerves. These rami are distributed wholly to the epithelium of the branchial arches and are therefore comparable to the pre-trematic nerves of fishes. Drüner finds the same series of nerves in *Triton* and *Salamandra,* and the first two of the series in *Proteus* and *Menobranchus.*

As in some fishes, there is an anastomosis in *Amblystoma* between the ramus post-trematicus IX. and the first ramus pre-trematicus X. In some individuals there is a similar anastomosis in the second and third branchial arches and in the hyoid arch between the facial and glossopharyngeus. The latter has been found by Drüner in *Triton.*

2. The ramus alveolaris VII. of *Amblystoma* is a pre-spiracular nerve and, as such, cannot be homologous to the ramus mandibularis internus of *Anura.* These two nerves innervate homologous areas and terminate in homologous centers in the brain. They differ, however, in the following important features: (*a*) The ramus alveolaris passes anteriorly of the derivative of the spiracular cleft, while the mandibularis internus passes caudally of that structure; (*b*) the alveolaris passes dorsally of the mylohyoid muscle, while the mandibularis internus passes ventrally of that muscle; (*c*) the alveolaris anastomoses with the trigeminus while the mandibularis does not.

These differences may be explained by reference to *Squalus acanthius,* in which both nerves are present. Here the areas innervated by the two nerves in part coincide and the terminal fibers of the two anastomose. Obliteration of a pre-spiracular nerve of the selachian type in *Anura,* and of a like post-spiracular nerve in *Amblystoma,* would give the two divergent amphibian types of distribution of the facialis.

The Anatomy of the Drumming Organ in some Marine Fishes: A. K. Krause.

The Cell-Lineage of the Mesoblast-Bands and Mesenchyme in Thalassema: John Cutler Torrey. (Read by title only.)

As in many other annelids and mollusks the middle germ-layer has, in *Thalassema,* a double origin. The mesoblast-bands (entomesoblast or cœlomesoblast) arise in the typical manner from D.4, the posterior member of the fourth quartet, which also contributes two small, but not rudimentary, cells to the posterior part of the gut. The 'larval mesenchyme' (ectomesoblast or pædomesoblast) arises, as in most other forms, from cells of the earlier or ectoblastic quartets; but whereas in the forms hitherto described it arises from only one quartet and only in certain quadrants, in *Thalassema* it arises from all of the three quartets and in all of the quadrants (though this latter statement does not apply to all of the quartets). At least twenty primary ectomesoblast cells are formed; but of these only ten are functional, while at least ten are rudimentary and disappear without becoming functional. Of the functional mesenchyme-cells, three are derived from the third quartet and seven from the first. These give rise not only to the larval muscles, but also in part to those of the adult. Of the rudimentary cells, six arise from the first quartet and one from each quadrant of the second quartet. These cells pass into the interior of the entoblast cells, are absorbed, and wholly disappear. They are probably to be regarded as vestigial cells which have been supplanted by other mesenchyme cells.

A Case of Compensatory Regeneration in Hydroides dianthus: C. ZELENY. (Read by title only.)

Primary Hexamerism in the Rugosa (Tetracoralla): J. E. DUERDEN. (Read by title only.)

Numerous serial sections of the rugose coral, *Lophophyllum proliferum* (McChesney), prepared for the author by the United States National Museum, enable him to confirm the observation of Pourtalès in 1871 that six primary septa occur at the tip of the corallum. Duncan and Kunth have independently found the Palæozoic *Heterophyllia,* and Frech the Devonian *Decaphyllum,* likewise to be primarily hexameral, while apparently no sections of any rugose types have been described revealing only the four primary septa which are usually assumed to be characteristic of the Tetracoralla. There is good reason for concluding that the Palæozoic corals were primarily hexameral, as is the case with modern corals and actinians (Ceriantheæ excepted).

The serial sections of *Lophophyllum* beyond the tip permit of the order of appearance of the later septa being established. These are found to arise in bilateral pairs within four of the primary interseptal chambers in conformity with Kunth's law. Instituting a comparison of this method of septal increase with what is known of the mesenterial and septal succession in modern Zoantharia, it is shown that the rugose corals are very closely related to the living Zoanthid polyps. In the latter new mesenteries appear at one region within only two primary exocœlic chambers, while in the Rugosa they must have appeared in the same manner within four primary chambers and rarely within six. The Zoanthids probably bore much the same relationship to the corals of Palæozoic times which the actinians of today bear to recent corals.

The Course of the Blood Flow in Lumbricus: SARAH WAUGH JOHNSON. (Reported by J. B. Johnston.)

The course of the blood flow in *Lumbricus terrestris* was studied by watching the pulsations, cutting the vessels, holding with forceps, and by various combined and indirect experiments. The main result is to show that the circulation in *Lumbricus* is not fundamentally a segmental one, upon which a partial systemic circulation has been superimposed, but is wholly systemic. The blood flows forward in the dorsal vessel to the extreme anterior end of the worm, downward in the hearts, and in both directions from the hearts in the ventral vessel. The flow is backward in the subneural vessel and upward from the subneural to the dorsal in the parietals. From the ventral vessel the blood goes to the intestine, body wall, and nephridia. From these organs it is gathered up by the dorso-intestinals, branches of the subneural, and parietals, and emptied into the dorsal. Thus the blood is carried backward by the longitudinal trunks on the ventral side of the body, upward through the body wall, intestine, nephridia, etc., to the dorsal, and forward in the dorsal to the hearts. Since the flow is upward in all the circular vessels, no complete circuit within a single segment is possible for any part of the blood. In the anterior end of the worm blood is carried forward by both the dorsal and ventral vessels, and backward by the subneural and lateral vessels. The latter have connections in several segments with the subneural, anastomose with the parietals of segments XII. and XIII., receive blood from the body wall, nephridia, and seminal vesicles, and empty into the dorsal vessel in segment X. and, by way of the parietals, in segments XII. and XIII. This system is to be considered as representing the parietal vessels of the region in front of the last pair of hearts.

A Contribution to the Arterial System in Cryptobranchus: H. H. Keener.

Presented by J. B. Johnston. (Read by title only.)

The Larva of Naushonia crangonoides: Millett T. Thompson.

It was my good fortune, while at Woods Holl last summer, to identify and rear the larvæ of *Naushonia crangonoides* (Kingsley), a small Thalassinid Crustacean taken near Wood's Holl in 1893.

Three zoëa and two mysis stages are recognizable, during which stages the metamorphosis is inconsiderable, the 'habitus' being similar in all. The mysis phase, however, closes with a sharp change, the adolescent phase resembling the adult more closely than is usual among the Crustacea. The zoëa and mysis phases of this species are distinguished from all other known Crustacean larvæ—with two exceptions—by their peculiar form. The carapax is elongated behind the eyes into a 'neck'; the rostrum is short and arcuate; the body is without spines, though the anterior abdominal segments bear hook-shaped processes at their posterior angles; the sixth segment of the abdomen is very elongate. The mandibles are remarkably asymmetrical, although symmetrical in the adolescent stages and hence probably in the adult.

Two other larvæ resemble these in form; a larva of unknown parentage from the English coast, in regard to whose mandibles data are lacking; and the well-known larva of *Calliaxis adriatica* (Heller). The mandibles of the latter are like those of the *Naushonia* larva in shape, and similarly the one on the left is hook-shaped and the one on the right conical. Leaving out of the question the too little known English form, we find that the likeness between the larvæ of *Naushonia* and those of *Calliaxis* is not due to convergence, but to a close relationship existing between the species. This is easily demonstrable by comparing the adults of the two species.

Calliaxis and *Naushonia* do not seem to be very closely related to the other species grouped in the Thalassinidea, excepting possibly *Laomedia* (DeHaan). They perhaps represent a group which has approached the Thalassinidea in some respects, but whose descent must be sought along a different line from that of the other genera of this group.

On the Spinal Homologues of the Cranial Nerve Components: J. Playfair McMurrich.

The researches of Strong and C. J. Herrick have demonstrated the existence in the cranial nerves of five distinct components which may be termed the lateral line, somatic sensory, viscero-sensory, median motor and lateral motor components. The first of these are undoubtedly confined to the cranial region, but of the other four it seems probable that homologues exist in the spinal nerves. The somatic sensory components, being supplied to the skin, are naturally to be homologized with the components of the dorsal spinal roots which have a similar distribution, and the equivalents of the viscero-sensory fibers, distributed to the endodermal sense-organs and epithelium, are to be looked for in those sensory fibers from the posterior root ganglia which accompany the efferent fibers of the sympathetic system to the viscera.

As regards the two motor components, the homologues are not so apparent. The observations of van Wijhe have shown that the cranial muscles belong to two categories, the musculature of the branchial arches being derived from the ventral mesoderm and the remaining cranial musculature from the dorsal mesoderm. It is noteworthy that the branchial musculature is supplied by lateral motor nerves and by these alone, while the dorsal musculature is supplied by median motor roots. Consequently the nerves supplied to the myotomic muscles of the trunk are to be regarded as the homologues of the cranial median motor nerves, while the white rami fibers, which control through sympathetic neurons the visceral musculature of the trunk derived from the ventral mesoderm, are the equivalents of the cranial lateral motor components.

The other ideas referred to in the paper may, for lack of space, be stated summarily. (1) The distinction between voluntary and involuntary muscles is a physiological and histological one, and not morphological, and the branchial musculature is morphologically equivalent to the visceral musculature of the trunk. (2) The branchiomeric segmentation is not identical with the myotomic, but in the cranial region there exist together two distinct segmentations. (3) Of these the branchiomeric segmentation is probably the older phylogenetically.

Geographical Distribution of Fresh Water Fishes of Mexico: S. E. Meek. (Read by title only.)

Feeding Habits of a Spatangoid, Mœra atropos; a Brittle-Star Fish, Ophiophragma Wurdmannii, and a Holothurian, Thyone briareus: Caswell Grave.

The observations here given were made on animals kept in the Beaufort U. S. F. C. Laboratory in aquaria in which a balance had been established between animal and plant life by means of diatoms. The spatangoids were reared from plutei.

The function of the so-called ambulacral brushes of spatangoids, which are so conspicuously waved about in the water above the animals when dug up and placed in aquaria, has been thought to be principally a respiratory one, but I have found that the animals use these brushes as hands for grasping bunches of sand and diatoms and carrying them to the mouth, the bristles of the brush being used as fingers.

Ophiophragma lives below the surface of the sand, with the oral surface of its disc and arms applied to some large object and with the tips of its arms extending into the water above. The foot-tentacles, distributed in pairs along each arm, are seen to be in constant waving motion, and by close observation it may be seen that they are busily engaged in passing little pellets of sand and diatoms toward and into the mouth. Down the oral surface of each arm is travelling a procession of pellets which have been gathered up by the more terminal tentacles and which are being successively handed on by the more proximal pairs.

Thyona, in feeding, fully extends the long branching tentacles which surround its mouth, and mops them about in the sand until they are well covered with sand grains and diatoms; then they are, one by one, turned back and poked down the throat; the mouth closes around the base of the tentacle and, when withdrawn, it is free from all débris.

A Method of Rearing Marine Larvæ: Caswell Grave.

A method of rearing echinoderm larvæ which I have used for two seasons with much success consists in supplying the aquaria containing them with a generous amount of sand containing diatoms.

From twelve to twenty-four hours after fertilization, the eggs reach a stage in which they swarm at the surface of the water. At this time it is easy to get a pure culture of larvæ by skimming the surface of the dish in which the eggs were fertilized. The larvæ thus collected are placed in an aquarium of fresh sea water. At the same time there are also added a dozen or more pipettefls of the *surface* sand from an aquarium containing a culture of diatoms. (Prepared by putting a liter or more of sand, dredged from the ocean bottom, in an aquarium of sea water and allowing to stand several days.) The jar thus stocked is now covered and set before a window, where it is well, but indirectly, lighted.

The diatoms keep the water *pure* and furnish an abundant supply of the *natural food* of the larvæ, and, because of the balance established in the aquarium between animal and vegetable life, the supply of *oxygen* is kept constant and there is no need for frequent changes of water. The larvæ are thus protected from the destructive effects of *rapid changes in temperature* produced when fresh ocean water is added to that which has stood in the house.

A number of spatangoids and sand-dollars, which had just completed their metamorphosis on September 22, have been kept in a healthy and growing condition to the present time (January 1) in such a diatom-stocked aquarium holding one liter. The water has been changed twice during the three months in order to replace the salts used by the diatoms and echinoderms.

Abnormalities in Development of Hybrid Fishes: W. J. Monkhaus. (Read by title only.)

On the Genera of the Hydracarini: Robt. H. Wolcott.

However much we may pride ourselves on the naturalness of our present classification, it nevertheless must be admitted that it is a purely artificial device. Thus it seems legitimate to make use of every modification, however artificial it may be, which increases its serviceability without at the same time doing violence to any of our accepted ideas concerning phylogenetic relationships. In the characterization of various groups, of higher or lower rank, authors have made use frequently of characters so dissimilar as to make it difficult to compare the descriptions or to reduce them to such form as to make them serviceable in a general treatment of the subject. If, in any group, characters can be found which are of family value, others which are generic, and still others clearly specific, while all other variations can be recognized as within the limits of specific variation, systematic work in the group will be greatly facilitated by the recognition of the fact and a clear definition of the value of each factor. It is evident that for each collection of forms that may be treated together in this manner, however many may be thus included, characters will be found which are peculiar to those forms and other characters must be found for any other similar collection. It is also evident that any character which would otherwise be of a given value may, if greatly developed, have its value so increased as to become a character of the rank next above, especially if accompanied by other characters of the higher rank. If this development stand alone it is better to consider it in the line of aberrancy within the lower group. It is further desirable, as soon as these characters may be determined upon for any group, that for the subdivisions of that group diagnoses be formulated which shall bring these characters sharply into contrast; and in the interest of accuracy it is desirable that each of these diagnoses should contain in the briefest possible form a statement concerning all the characters belonging to a subdivision of that rank. Furthermore, for each group a type should be selected in accordance with the recognized rules of priority. When for any group such diagnoses of the different subdivisions shall have been published, and, after discussion, so modified as to be acceptable to the majority of students of the group, forms subsequently described should be accompanied by similar diagnoses and similar designations of a type which will render them strictly comparable to forms already known.

The Hydracarini form a sharply limited and very homogeneous group in which the application of such a scheme as proposed above seems practicable. Accordingly, it is suggested here, and in the complete paper it is expected that there will be given for each family and genus: first, the name having priority; second the author of the same, together with the date and exact reference; third, a diagnosis in Latin and English; fourth, the type, with reference to the author and exact date, together with the reasons for selection of the same.

Southeastern United States as a Center of Geographical Distribution of Fauna and Flora: CHARLES C. ADAMS. (Read by title only.)

In general the geographical relationship of the fauna and flora of the northern United States, east of the Great Plains, is with that of the Southeast, and points to an origin in that direction, except in the case of the distinctly boreal forms. The abundance and diversity of life in the Southeast indicate that it has been, and now is, a center of dispersal. The relicts indicate that it has been a center of preservation of ancient types, and the endemism shows that it has been a center of origin of types. There are two distinct southern centers of dispersal in temperate United States, one in the moist Southeast and the other in the arid Southwest. Nine criteria, aside from fossil evidence, are recognized for determining the center of origin or the locality of dispersal: (1) Location of the greatest differentiation of a type; (2) location of dominance or great abundance of individuals; (3) location of synthetic or closely related forms; (4) location of maximum size of individuals; (5) location of greatest productiveness and its stability, in crops; (6) continuity and convergence of lines of dispersal; (7) location of least dependence upon a restricted habitat; (8) continuity and directness of individual variations or modifications radiating from the center of origin along the highways of dispersal; (9) direction indicated by biogeographical affinities and (10) annual migration routes in birds. There are three primary outlets of dispersal from the Southeast: (1) The Mississippi Valley and its tributaries; (2) the Coastal Plain, and (3) the Appalachian Mountains and adjacent plateaus. The first two have also functioned for tropical types and the third for boreal forms. Dispersal is both forward and backward along these highways. It is desirable to study individual variation of animals and plants along their lines of dispersal and divergence from the center of origin, in such characters as size, productiveness, continuity of variation, color variation, and changes of habit and habitats. Life areas should be studied as centers of dispersal and origin and hence dynamically and genetically.

Description of Cephalogonimus vesicaudus, sp. nov.: W. S. NICKERSON. (Read by title only.)

Fresh Water Polychæta: H. P. JOHNSON.

The Lateral Line System of Polyodon spathula: HENRY F. NACHTRIEB.

The paper considered only the general anatomical features of the lateral line of *Polyodon*. In general the systems of the two sides are symmetrical, but in the position, distribution, number and minor details of the branches from the 'lateral' and 'main' canals there is considerable variation. In none of the several hundred specimens examined were these branches grouped as described and figured by Collinge. In all cases they were found all along the 'lateral' canal, the great majority being ventral to the canal. As a rule, one to three at the anterior end of each system begin on the ventral side of the canal and, after running a short distance in that direction, turn dorsalward and terminate in the usual branchlets and clusters of sense organs on the dorsal side of the canal.

The points made were demonstrated with dried skins of the fish upon which the systems had been painted over with white paint, and photographs of similarly prepared skins.

Conditions of Fossilization: J. Culver Hartzell. (Read by title only.)

Professor Hartzell's paper was a review of a series of investigations he has been making, the objective point of which is to find the laws (?) governing the conditions of fossilization for the various classes of Invertebrates in the same and in different formations.

Before the laws desired can be formulated, it is necessary (*a*) to know the mineral composition of the skeletal parts of living invertebrates; (*b*) to know the condition of the fossil, *i. e.*, whether it be the original, a mold or a cast; (*c*) to know the mineral composition of the fossil; (*d*) to know what mineral change has taken place during fossilization where the cast is one by molecular replacement; (*e*) to know the lithological composition of the formations in which fossils occur; (*f*) to know the relationship between the fossil and the formation.

The conversion of an organism into a fossil depends upon the character of its skeletal parts, the material in which it is buried and the material brought in in solution by infiltration. The material of which the skeletal parts is composed varies in different groups, being more durable in some than in others and therefore plays an important part in the preservation of the organism. The variation in the lithological character of the material in which the organism is buried also plays an important part. Certain organisms are preserved as originals, others as molds and casts, in the same formation, and locality. In this same formation, but in a locality of different lithological character, those groups which were lost under the former condition may be retained under the latter, and *vice versa*.

So far, twenty-five horizons and forty-four localities in the United States, Canada, England and Germany have been examined with special reference to the lithological character of each formation at the various localities and the conditions of preservation of the fossils. Tables have been prepared giving the general mineral character of the skeletal parts of living invertebrates, minerals replacing original minerals secreted by the organisms, and a comparative table showing the mineral composition of living and fossil invertebrates.

The paper was illustrated by means of photographs, drawings and models.

Origin and Migration of the Germ-Cells in Squalus Acanthias: Frederick Adams Woods.

The germ-cells in this form are not derived from the germinal epithelium of the body cavity, as is commonly taught, but are traceable before the mesoderm has split to form the cœlom, and in a region that may be called extra-embryonic.

In the earliest stages in which they can be distinguished from body cells they all lie in two little round groups under the blastodermic rim in the posterior part of the embryo, and just at the junction of the three germ layers as well as in the endoderm itself.

During the growth of the embryo these clusters move inward from each side towards the median line. (Embryo of 3 mm.)

The cells then become separated from each other and are scattered in the unsplit mesoderm, though none are yet to be found in the segmented portion of the middle germ layer.

When the mesoderm splits, nearly all succeed in getting on the median or splanchnic side of the body cavity which is then formed.

From this time up to the period of sexual differentiation (embryo of 28 mm.) these cells migrate relatively to the other tissues so that they progressively lie just beneath, at the side of and then dorsalward to the intestinal tract. They then make their way through the mesentery in which most of the cells are found (embryos of about 11 mm.), and finally reach their destination in the epithelium of the genital gland.

During no part of this process are germ-cells ever derived from mesoderm cells, nor do they ever go into the formation of any part of the body.

They retain their yolk and other characteristics of the cells of the early blastoderm stage and it is the body-cells, not the germ-cells, that are differentiated.

Thus the hypothesis of Naussbaum that 'sex cells do not come from any cells that have given up their embryonic character or gone into building any part of the body, nor do sexual cells ever go into body formation,' finds a confirmation in facts.

Histological Changes in the Regeneration following Normal Fission of Planaria maculata: W. C. CURTIS. (Read by title only.)

Variation in the Hepatic Ducts of the Cat: R. H. JOHNSON. (Read by title only.)

An Electric Lamp for Microscope Illumintion: MAYNARD M. METCALF. (By title.) Will be published in full in SCIENCE.

M. M. METCALF,
Secretary.

AMERICAN PHILOSOPHICAL ASSOCIATION.

THE American Philosophical Association held its first meeting at Columbia University, New York, on Monday and Tuesday, March 31 and April 1, 1902. The Association may be regarded as a daughter of the American Psychological Association, to which fully three fourths of its nearly one hundred charter members also belong. For several years past the Psychological Association has provided for the reading of papers in general philosophy at its meetings by philosophical sections. This arrangement generously met a practical demand, but the relation was anomalous. The desire for more adequate recognition of the philosophical interests was met by the organization of the new Association at a conference held last November in New York. Professor J. E. Creighton (Cornell), editor of the *Philosophical Review*, was chosen president, Professor A. T. Ormond (Princeton), vice-president, Professor H. N. Gardiner (Smith), secretary-treasurer, and these, together with Professors Armstrong (Wesleyan), Duncan (Yale), Everett (Brown) and Hibben (Princeton), were constituted an executive committee to invite others to membership, to draw up a constitution and to arrange for the first meeting. The constitution adopted at the recent meeting defines the object of the Association as 'the promotion of the interests of philosophy in all its branches, and more particularly the encouragement of original work among its members.' The relation of the Association to the previously established Western Philosophical Association was referred to the executive committee to report at the next meeting. The next meeting will be held in Convocation Week in Washington in affiliation with the other societies, part of the time, probably, in joint session with the Psychological Association. The officers for the ensuing year are president, Professor A. T. Ormond (Princeton), vice-president, Professor, A. Meiklejohn (Brown), secretary-treasurer, Professor H. N. Gardiner (Smith), and the other members of the executive committee, Professors A. C. Armstrong (Wesleyan), J. G. Hibben (Princeton), W. Caldwell (Northwestern) and D. Irons (Bryn Mawr). The following is the list of papers read at the recent meeting:

Monday, March 31.

10 A.M.

'Poetry and Philosophy': Dr. Ralph Barton Perry.

'Recent Criticism of the Philosophy of T. H. Green': Professor William Caldwell.

'The Æsthetic Element in Human Nature': Professor E. Hershey Sneath.

2 P.M.

'Address of Welcome': President Nicholas Murray Butler.

'The Functional Theory of the Distinction between the Psychical and Physical': Professor H. Heath Bawden.

'The Atomic Self': Professor George Stuart Fullerton.

8 P.M.

Address of the President. Subject, 'The Purposes of a Philosophical Association': Professor James Edwin Creighton.

Discussion on the Address: President Francis L. Patton.

Tuesday, April 1.

10 A.M.

'The Concept of the Negative': Dr. W. H. Sheldon.

'Being, Not-Being and Becoming: a Study in the Logic of Early Greek Philosophy': Professor Alfred H. Lloyd.

'Aristotle's Theory of Reason': Professor William A. Hammond.

'On Final Causes': Dr. Edgar A. Singer, Jr.

'On the Study of Individuality': Professor J. A. Leighton.

2 P.M.

'The Consciousness of Obligation': Professor E. B. McGilvary.

'Kant and Teleological Ethics': Professor Frank Thilly.

'Epistemology and Ethical Method': Dr. Albert Lefevre.

'The Epistemological Argument for Theism': Professor Edward H. Griffin.

'The Philosophy of Religion: Its Aim and Scope': Dr. F. C. French. (Read by title.)

A pleasant feature of the meeting was the reception given to the members, about forty of whom were in attendance, by President and Mrs. Butler in the Avery Library on Monday evening. The thanks of the Association are also due to President Butler and the officers of the University for the admirable accommodations in Earl Hall.

H. N. Gardiner,
Secretary.

SCIENTIFIC BOOKS.

Inorganic Evolution as Studied by Spectrum Analysis. By Sir Norman Lockyer, K.C.B., etc. London, Macmillan and Co. 1900. Pp. vi+198; 44 figs.

The author states in his preface that this 'volume contains an account of my most recent inquiries into the chemistry of the stars, and of some of the questions which have grown out of these inquiries.' Dissociation is the main topic of the book, and the author makes the 'endeavor to show how, in the studies concerning dissociation, we have really been collecting facts concerning the evolution of the chemical elements,' and he points out 'especially that the first steps in this evolution may possibly be best studied by, and most clearly represented in, the long chain of facts now at our disposal touching the spectral changes observed in the hottest stars.'

The separate 'books' into which the small volume is divided are entitled as follows: I., 'The Basis of the Inquiry'; II., 'Application of the Inquiry to the Sun and Stars'; III., 'The Dissociation Hypothesis'; IV., 'Objections to the Dissociation Hypothesis'; V., 'Inorganic Evolution.' The work therefore deals with a chemical problem by the methods and with the results of astronomy. It does not primarily treat of the theory of stellar evolution, which is now being gradually built up on the foundation of the new facts of astronomy and astrophysics. The author presents his evidence in his usual brilliant manner, and it is easy to see how one may be carried along to his conclusions, if the evidence is not carefully examined. The dissociation hypothesis is undoubtedly a particularly alluring one to the astronomer, as presenting a comparatively easy escape from some of the difficulties of solar and stellar physics. But the validity of the evidence upon which any such theory is based should be beyond question, and this cannot be said of some of the evidence here presented. It is also very doubtful if other workers in these lines can share Sir Norman's optimistic view expressed on page 29: "I propose to pass over the history of nearly twenty years' work, with all its attendant doubts and difficulties, and deal with what that work has brought us, a perfect harmony between laboratory, solar and stellar phenomena." To many it may appear that the discoveries of facts in spectroscopy in recent years have tended to temporarily diminish rather than increase the harmony between the phenomena observed in the laboratory and the heavens.

The reviewer's copy of the book contains many marginal queries as to the correctness of the evidence brought forward as representing the facts. Thus, for instance, we read on page 34 of "the simplification of the spectrum of a substance at the temperature of the chromosphere. To take an example, in the visible region of the spectrum, iron is represented by nearly a thousand Fraunhofer lines; in the chromosphere it has only two representatives." Now recent photographs of eclipse spectra—and first of these that obtained in 1896 by Sir Norman's assistant, Mr. Shackleton—actually show the presence of a great number of iron lines at the base of the chromosphere, matching almost every one of the strong dark lines ascribed to iron in the solar spectrum. In several places the assertion is made that the lower chromosphere is certainly not the origin of the Fraunhofer lines, although the author's own photographs of the 'flash spectrum' at the Indian eclipse of 1898 clearly contradict this.

We are surely much indebted to Sir Norman for his valuable researches on the lines having greater intensity in the spark than in the arc spectrum, to which he has applied the term 'enhanced lines.' But it is difficult to avoid the impression that he attaches an exaggerated importance to their significance in solar and stellar spectra. To the vapors producing the enhanced lines he prefixes 'proto,' as proto-magnesium, proto-iron, suggesting that at high spark temperatures a finer form of the element is developed. The spectrum of α Cygni is considered to contain chiefly the enhanced lines; numerically, 120 enhanced metallic lines were found in approximate coincidence with some of the 307 lines measured in the spectrum of α Cygni; or, dealing only with the strongest lines, 'the coincidences with enhanced metallic lines with the dispersion employed amount to 38' out of 40. The reviewer has not been able to fully confirm this resemblance on comparing the wave-lengths found in α Cygni by other observers with Sir Norman's lists of enhanced lines of metallic spectra, and had hoped to make the comparison on recent plates taken at the Yerkes Observatory; but this would have too long deferred this review. However, one of the points especially emphasized by Sir Norman is the superior temperature of the reversing layer of α Cygni to that of the sun. As his reasoning is based on the incorrect premise that the reversing layer lies outside the chromosphere, the conclusions are not convincing. On this and similar evidence is constructed the author's elaborate and ingenious classification of stars into genera depending upon their density and temperature, divided into ascending and descending branches. The reviewer must confess his inability to understand clearly Professor Lockyer's differentiation between descending and ascending stars, although not wishing to question the probability that both branches exist.

In subsequent chapters the author interestingly discusses the bearing upon the dissociation hypothesis of the recent discoveries of series in the spectra of the elements, of pressure shifts of lines, of magnetic perturbations (Zeeman effects), and of the 'fractionation' evidence. He finds in them a quite satisfactory confirmation of his hypothesis, and displays great skill and command of the subject in marshaling to its support the data from such various sources.

As has been said of other volumes in this series, the illustrations do not adequately reproduce the author's original photographs, and could be greatly improved upon in a future edition.

EDWIN B. FROST.

Outlines of Electrochemistry. By HARRY C. JONES, Associate Professor of Physical Chemistry in the Johns Hopkins University. New York, The Electrical Review Publishing Co. Price, $1.50.

The author has not tried to give an exhaustive account of electrochemistry, for he prepared the seven chapters, which cover about one hundred pages, for a technical journal, whose readers are for the most part men busy in every field of applied engineering science; consequently he wisely selected those theoretical topics which would appeal most strongly to this particular class of students. The book, however, will prove instructive and helpful to all who wish to get a clear and definite knowledge of the subjects it presents. The writer has read it with profit, and feels sure that he does not err in recommending it. One might, however, well ask whether 'the whole subject of the electrolytic separation of the metals was opened up' (p. 44) through the study of the decomposition values of the ions by LeBlanc, Freudenberg and others in Ostwald's laboratory, when it is recalled that all but three or four of the separations recorded by these chemists had been made long before by others? Or, if 'the decomposition values of the ions' is the vital point, should we omit mention of the work of Kiliani, who first carried out metal separations by attention to the differences in electromotive force? Perhaps these may be regarded as minor matters, but the historical development of the subject calls for their presence.

EDGAR F. SMITH.

Enzymes and Their Application. By Dr. JEAN EFFRONT. Vol. I., The Enzymes of the Carbohydrates. Translated by SAMUEL C. PRESCOTT. New York, John Wiley & Sons; London, Chapman & Hall, Limited. 1902. 8vo. Pp. 322.

This is a very excellent work and is a valuable addition to the literature on enzymes and their application. The book is designed to meet the wants of not only scientific investigators, but also of those interested in the industrial application of these substances, and will be appreciated by both classes. The author has carried out his purpose in a clear, concise manner. From the standpoint of theoretical consideration he is careful and conservative, and his treatment of the technical application of enzymes to commercial practices is unusually full and clear for a work of this kind. The book is more than a compilation, inasmuch as the author has, as stated in the preface and borne out by internal evidence, confirmed in his laboratory most of the facts presented. The second volume which is now in course of preparation, will take up the proteolytic enzymes and the toxins, and its appearance will be looked for with interest. Professor Prescott is to be congratulated in presenting a translation that in no way detracts from the original. The printing is well done and the paper and binding good.

ALBERT F. WOODS.

BUREAU OF PLANT INDUSTRY,
U. S. DEPARTMENT OF AGRICULTURE,
WASHINGTON, D. C.

Animals of the Past. By FREDERIC A. LUCAS. New York, McClure, Phillips & Co. 1901.

One who has had much to do with a public museum of extinct vertebrates is pretty sure of the queries that the ordinary sight-seer will propose for answer. Meaningless bones will be clothed with new interest when it is learned that they are millions of years old, and that the place whence they came was once the bottom of an ocean or broad lake. And he invariably desires to learn how it is known where to dig for them, how they are preserved, and a multitude of similar things. It is very evident that the author of 'Animals of the Past' has had no inconsiderable experience in answering such questions, else he could hardly have encompassed within its pages so much and so clear information about those things that the general public desires most to know concerning fossils. We will not quarrel with him for the omission of a limiting adjective in the title, nor suggest that some of its humor is a trifle far-fetched, in consideration of the fact that the book on the whole is very good. One who is acquainted with the author's work in paleontology will expect accuracy and reliability, and he will not be deceived here. He has kept his imagination in check—not always an easy thing for the paleontologist to do!—and has said what he has to say in an easy way that even the schoolboy will enjoy. The book is, moreover, scientific, and not a collection of paleontological fables; it is, I think, the best of its kind yet published. It tells how the bones of extinct animals become fossilized, are found, collected, restored and mounted, of the many problems they present and the inferences they suggest, the causes of growth and decay among the animals of the past, etc.; matters that really interest the general reader quite as much as details concerning creatures which he can only imperfectly comprehend. But the contents would belie the title, were this all. Many of the largest, most interesting and remarkable of extinct backboned animals, the rulers of the air and sea and dry land, mastodons, mammoths, horses and the like are described, and illustrated by restorations as in life from the skilful brush of Gleeson and Knight. Knight's reputation in such things is well known—his work is the very best, but Gleeson in the present instance comes a close second to him. The book is a good one for both the public and private library.

S. W. WILLISTON.

SCIENTIFIC JOURNALS AND ARTICLES.

The Osprey for February contains 'Notes on the Habits of the Broad-winged Hawk (*Buteo platypterus*) in the Vicinity of Washington, D. C.,' by J. H. Riley; 'Rambles about my Old Home,' by Milton S. Ray; 'The Mocking Bird at Home,' by F. H. Knowlton; 'Reminiscent, Random and Maine Bird Notes,' by W. C. Kendall, and a sketch, with portrait, of that most able ornithologist, 'Professor Alfred Newton,' by R. W. Shufeldt. The supplement, devoted to the 'General History of Birds,' contains a description of the general characters of the class and of the plumage.

The Plant World for February contains 'A Botanical Ascent of Mount Kataadin, Maine,' by John W. Harshberger; 'Another Trip to Glen Burnie, Maryland,' by C. E. Waters; 'Botanizing in Winter,' by C. F. Saunders, and 'A Primrose at Home,' by F. H. Knowlton, besides the usual and numerous notes and briefer articles which contain much of interest. In the 'Families of Flowering Plants' Charles L. Pollard concludes the description of the orders Opuntiales and Myrtifloræ and commences that of the Umbellales.

The Museums Journal of Great Britain for February contains an article on 'Museum Statistics,' intimating that it is desirable to know just how they are obtained, whether by estimate or by actual record. J. G. Goodchild presents an article 'On the Arrangement of Geological Collections,' and there is a sharp bit of criticism on some recent 'British Museum Appointments' in the entomological section. The subject of 'Hygiene as a Subject for Museum Illustration' is continued, showing the proposed arrangement of the divisions water, soil and personal. There is a large number of notes.

The American Museum Journal for February presents a review of the current work of the various departments and their more notable accessions, which include a good collection of mammals from Alaska, a fine skull of the woolly rhinoceros (*R. tichorhinus*) and a good series of butterflies from the Australasian region. This month's supplement is the Guide

Leaflet, describing 'The Collection of Minerals.'

SOCIETIES AND ACADEMIES.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

The 549th regular meeting was held March 15, 1902. The evening was devoted to a discussion 'On the Definition of Some Modern Sciences.'*

Dr. W. H. Dall opened the discussion with a reference to the early history of the Society, when all the scientific men of Washington belonged to it, and the splitting up into numerous societies had not begun. He quoted some of the definitions of science from the earliest English dictionaries, and in felicitous words welcomed the speakers who had been invited to follow him, and characterized their subjects.

Col. Carroll D. Wright spoke on 'Statistics.' The name is due to Achenwall, Professor at Göttingen about 1750. It may be considered either as a method, or as a science demanding a classification of facts. Numerous fallacies in the collection and use of statistical data were illustrated, and attention was called to the importance of the psychological element in the interpretation of such data; thus, it was found that nearly all the farm mortgages in 1890 were evidences of prosperity rather than of adversity.

Professor Roland P. Falkner, now in charge of the Document Division, Library of Congress, discussed 'Economics.' The limits of a science, he said, are largely questions of the division of labor. So definitions vary, but the consensus of opinion is that economics deals with man in his activities, which are designed to satisfy his material desires, in short with wealth. From an analysis of his wants the metaphysical side of the subject has been developed. His wants being unlimited and nature's provision being limited, man must put forth effort; the character of this effort and the rules which govern it are the subject matter of political economy. The form which economic organization assumes at any time and place depends upon the abundance of land, labor and capital: whatever the form, the 'economic man' seeks the maximum result with the minimum effort. The axioms then of the theoretical or deductive economists are the limitations of nature's gifts, and the economic man. The newer school of inductive economists concerns itself minutely with the affairs of the past as well as the present, and is known also as the historical school.

Professor Edward A. Pace, of the Catholic University, spoke on 'Psychology.' He pointed out that the subject is now in a transition state. The older psychology, based on introspection, was inductive, but dealt only with mental operations. The newer science has three methods or fields of research: It investigates the relations between mental and physical phenomena, the development of mental life, and abnormal psychic phenomena. There is a striking parallelism between many psychic and physical phenomena, and one of the great questions of the science is regarding a causal nexus between the two groups.

Dr. Lester F. Ward, speaking for 'Sociology,' defined it as the science of society or of social phenomena. It is based on the study of large groups of men, not of individuals. Tylor's ethnographic parallelisms prove a uniform law of psychic development; primary wants are the same and are similarly supplied everywhere; governments and religions have more in common than in diversity; history is everywhere the same except the names. Sociology can be a science only as it depends on phenomena; and these are due to causes. These causes may be grouped as (1) environment (climate, nature of country, etc.) and (2) subjective environment or character. The old doctrines of free will made man a lawless being, not a rational one. The law of parsimony runs through all life.

Charles K. Wead,
Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON.

The 352d regular meeting was held on Saturday evening, March 22.

W. C. Kendall presented some 'Notes on the Sticklebacks,' briefly sketching the habits and habitats of these little fishes and stating that in spite of their insignificant size they occurred at times in such vast numbers as to be used for fertilizer, as food for cows and

* To be published in the *Popular Science Monthly*.

dogs, and even for man. They were taken in large numbers in the brush weirs used for catching small herring on the coast of Maine, and in the same locality often became a nuisance by clogging the nets of the smelt seiners. The speaker then discussed the synonymy of the group at some length, stating that while he had at his command but few specimens from Europe, there seemed to be three species distinguished by varying conditions of body armature and caudal keel. These were *Gasterosteus aculeatus*, *G. semiarmatus* and *G. gymnurus*. The Pacific forms had been disposed of by Rutter as *G. cataphractus* (Pallas) (possibly the same as *G. aculeatus*); *G. microcephalus* Girard, and *G. cataphractus williamsoni; G. microcephalus* being considered as merely an intermediate form.

On the Atlantic coast there seemed to be no intergrading of species and Mr. Kendall considered that for the present these should stand as follows: *Gasterosteus aculeatus* Linnæus, *G. cuvieri* Girard, *G. atkinsoni* Bean and *G. bispinosus* Walbaum. This last was widely distinct from *G. aculeatus* and was not the *G. bispinosus* of Jordan and Evermann.

W. H. Dall gave some 'Notes on Trophon,' in which he traced the history of the genus *Trophon* of Montfort, which is of distinctly Purpuroid affinities and had long been confused with the Fusoid group named by Sars *Boreotrophon*, but which the speaker showed would have to take the earlier name of *Neptunea* Bolten.

The typical Trophons are chiefly austral in their distribution, but Mr. Dall has discovered that a certain number of species have succeeded in migrating northward until they have reached the North Temperate Zone. An interesting group of these occurs on the coast of California, but the more northern migrants are stunted and inconspicuous.

E. S. Steele gave an account of 'The Vegetation of Stony Man Mountain, near Luray, Virginia,' being a summary of observations made during August and early September of 1901. Nine conifers were noted, the most interesting being *Abies Fraseri*, the Fraser balsam fir, of which this may possibly be the farthest outpost northward. *Juncus trifidus*, sparingly known so far south, was collected on the peak. An apparent form of *Cyperus Houghtoni* with few flowers to the spikelet was found on a high headland of rock, and near it was a patch of *Arctostaphylos Uvaursi*, both plants far out of their supposed range. On the same ridge occurred *Astragalus Carolinianus*, unexpected at this altitude. *Anychia divaricata* Raf., a species long neglected, was studied in connection with *A. dichotoma*, and its independence vindicated. *Solidago Randii* Britton, a supposedly northern species, was found on all high ledges. Data were given concerning a species of *Lacinaria* believed to be the true *Serratula pilosa* Ait. *Aquilegia coccinea* Small and *Aronia atropurpurea* Britton, recently described species, were reported, as also the rather recent *Rubus raribaccus* Rydberg and *Vitis Baileyanus* Munson.

F. A. Lucas.

TORREY BOTANICAL CLUB.

At the meeting of the Club on February 26, the first paper was by Dr. John K. Small, on the 'North American Genera of the Cassiaceæ,' and will soon appear in print. Discussion followed regarding *Poinceana*, participated in by Dr. Britton, Dr. Underwood and Dr. Small.

The second paper, by Dr. Arthur Hollick, on the 'Flora of Provincetown, Mass.,' was accompanied by a series of maps, charts, views and mounted plant specimens. Dr. Hollick discussed the dependence of this flora upon the local geology, and remarked of Cape Cod that the older part from Highland Light through Truro has a surface of glacial drift; the recent part, through Provincetown to the north and west, consists of drifted sands, all post-glacial, derived from the older coast to the south and due to the general trend of the tides and currents northward. The result is to form a line of shoals along the coast now united into an outer beach; the space between this and the shore is now filling in and becoming swamp, and a new outer line of shoals is already forming. Nothing larger now grows on the sand-dunes than small stunted pines and oaks; but Bradford's account indicates that in 1620 it was covered with large deciduous trees. Acts to prevent further cutting of timber were passed in 1720, etc. At present the town of Provincetown forbids passing out of certain beaten paths in the wooded district, to prevent further loosening of the sand. Hundreds of acres have been replanted by the state, the lands of Provincetown having been successively reserved as common property of the colony, province and state; it is only within a few years that the land in actual occupation in and near the town has been granted by the state to the occupants. In reclaiming the sands, *Ammophila* or beach grass has been planted first, then bayberry, then *Pinus rigida*, the native pine of the region. Sand-loving species have since become well established as an undergrowth, but the new growth shows no sign of ever equalling the original. The same is true at Block Island, where the original forest had become established while the island was connected with the mainland. The sand flora is remarkable for the great areas closely covered with *Arctostaphylos Uva-Ursi;* this, with *Rubus hispidus* and some plants of *Corema Conradii*, is the chief means of forming the sand into turf. The species collected in Provincetown numbered ninety-four, among which *Corema Conradii* seems not to have been recorded from that town since Thoreau's visit in 1849.

The third paper was a note by Mr. A. P. Anderson on 'Tuckahoe or Indian Bread.' A specimen was exhibited, a mass about two feet long, made up of seemingly annual additions indicating ten years' growth. Similar specimens have been found in the South along roots of oak and other trees, usually about two feet below the surface, obtained chiefly when clearing land of old stumps. Undoubtedly a fungus growth, and probably a *Sclerotium*, it has never been seen to produce spores. The whole substance consists of a septated mycelium with abundance of white pectose. Europe contains the same species, and another in China has been used there for many centuries in medicine. Experiments by Mr. Anderson showed that portions separated from the roots of the host plant were alive in the soil after a half-year. Where the cortex was removed it was renewed.

A note by Rev. L. H. Lighthipe followed, with a communication from Mr. C. L. Pollard regarding his new species *Viola Angellæ*. He exhibited a water-color showing its spring and summer forms of leaf. An excursion for its collection about the Orange Mountains was suggested.

EDWARD S. BURGESS,
Secretary.

THE LAS VEGAS SCIENCE CLUB.

AT the regular monthly meeting, held February 13, Mr. E. L. Hewett presented the results of some studies of Navajo blankets, with special reference to the origin and meaning of the designs. Two blankets were exhibited which showed the Suastika design, which seemed to be especially prevalent among the Navajos, and not to have been derived from the older blanket-makers, the Pueblos. Unfortunately the most modern blankets were less beautiful and less interesting than the old ones, because the introduction of diamond dyes had led to the use of many inharmonious colors, and the makers also seemed frequently careless or ignorant of the meaning of the symbolic figures, employing them in a haphazard way.

T. D. A. C.

DISCUSSION AND CORRESPONDENCE.

SONG IN BIRDS.

TO THE EDITOR OF SCIENCE: Two articles on song in birds have recently appeared in SCIENCE, from the pen of Mr. W. E. D. Scott, of Princeton University.* The first of these, at least, has been widely read and freely quoted, and as an amateur bird observer I do not like to see such widely influential work passed by without comment, so I beg to offer a few criticisms.

In the first article, Mr. Scott raises the question as to how the song of each bird originates—whether it is inherited or acquired by some sort of education. He then details an experiment which was carried on, evidently with great care, for a period of nearly five years. Finally, he draws from his experiment

* SCIENCE, October 4, 1901, p. 522, and January 31, 1902, p. 178.

the reasonable conclusion that "two birds, *isolated from their own kind and from all birds,* but with a strong inherited tendency to sing, originated a novel method of song, and that four birds, *isolated from wild representatives of their own kind and associated with these two, who had invented the new song,* learned it from them and never sang in any other way." This piece of work seemed to show such carefulness in experiment, in observation, and in the conclusion drawn, as to deserve the highest commendation, and it raised the hope of good work to follow.

But this hope was not fully realized in the sequel. The second article is devoted to cases of birds having acquired new notes in various ways. Some of the statements in this paper are of value, but some show a very insecure foundation. For example, Mr. Scott quotes from Miss Emily B. Pellet, in *Bird Lore,* what he considers a 'well-attested case' of talking in a wild rose-breasted grosbeak. But a critical examination of Miss Pellet's article leads inevitably to the conclusion that the grosbeak was not talking at all, it was simply giving bird notes, and imagination put into them the likeness to human speech. This is indicated by the clear, musical character of the notes, by the peculiar non-human accentuation, and by the fact that the words were not repeated in parrot-fashion, but were freely rearranged in different sentences. Even if it were proved that the bird talked, it would be utterly unreasonable to conclude that it had learned to talk while a wild bird; the natural supposition would be that it had learned in captivity and had then escaped. The over-credulity of Mr. Scott in this case leads us to doubt the other examples he cites from unknown observers—those of the whistling and talking of canaries, and that of a duck imitating the call of a turkey. It is most important to know *how close* is the imitation in each case, for there is no subject on which popular evidence is so worthless as on the subject of mimicry. The crudest resemblance in appearance or in sound may be exaggerated into a case of 'perfect' imitation. We can find as much as we choose of this sort of evidence of mimicry.

As to Mr. Scott's own observations, there is one statement to be criticized, and that is that some birds reproduced the *direction* of a sound. What can this mean? It shows that Mr. Scott is not familiar with the psychologic basis of ventriloquism, or he would know that the ventriloquist can not indicate direction by his voice, but only by using some means to attract the attention of the listener to the desired point. And as for birds, it is highly improbable that they ever attempt to indicate the direction of a sound. Direction may be suggested by purely extraneous causes, and an example of this kind fell under my notice last spring which so well illustrates the point that I think it worth giving. I was standing on the top of a bluff overlooking a river-bottom; trees grew thickly in the bottom-land and up the bluff till just over my head. I heard the song of a robin, now loud and strong and apparently almost overhead; then very faint, and coming, as it seemed, from the tops of the trees in the bottom-land. From the robin's habit of singing a loud strain and a faint one alternately, it seemed probable that there was only one songster in this case, but it was almost impossible, at times, to avoid feeling that there were two birds, one almost overhead, and the other below my position, in the tops of the trees by the river. By changing my position I was able to see the bird, and to see that the same bird sang both songs. It was on a branch which overhung the bluff, being between the two positions from which the sound had seemed to come. In singing loudly, it had seemed nearer to me than it really was. Now, if it had been nearer, it would necessarily have been in the branches which were more directly overhead, and therefore I seemed to hear the sound coming down from those branches. But when the song sounded far away, it seemed too far to come from the trees of the bluff, and therefore I was forced to think that it came up from those of the bottom-land below. The case of Mr. Scott's birds is undoubtedly explicable in some similar way. The birds imitated only the sound itself, and the faintness of the sound, or the faintness combined with other qualities of the sound, was associated in his mind with surrounding circumstances so as to suggest the direction.

While the cases in which Mr. Scott was not critical enough in his work may be distinguished and passed over by the scientist, they may do a great deal of harm in another way —they offer a bad example to amateur observers. And the very excellence of part of Mr. Scott's work may become deleterious by increasing the influence of these bad examples. In reading the interesting nature books which are so numerous nowadays, it is a bitter disappointment to find, in one author after another, statements which are made without a secure foundation, and which therefore throw a shadow of doubt on all the assertions of that author. It will be truly deplorable if this sort of thing is to be encouraged by a specialist in ornithology in one of our universities. We expect that such a man will do much toward correcting the popular error, and will never contribute to it.

Wallace Craig.

Hull Zoological Laboratory,
March 4, 1902.

A GEOGRAPHICAL SOCIETY OF AMERICA.

Professor Russell's plan of a general geographic society (Science, January 31, 1901) is timely and deserves the careful attention of all the friends of geography in America. It is the very thing that is needed to unify the widespread interest which is daily waxing stronger in this country. A multitude of schools ask for a better presentation of geography, and urgent demands are made for teachers in the special fields of physiography and commercial geography. The universities have been slow in providing the training, and earnest teachers, making every effort to widen their margins and to increase their efficiency, have had great difficulty in finding the published material which will keep them in touch with what progress the specialists are making. Even the specialists have been slow to enroll themselves as geographers; their primary allegiance has been with the geologists, economists, botanists and the like. The field of general geography has never had adequate recognition by the very masters who have done most of the constructive work giving the general science body and impulse in this country.

It will mean much therefore if all this great headless body of earnest workers in the common field be given a head and a local habitation and a name. And if then all those persons of superior training and abilities be organized into a society having at heart the welfare of geography in the New World, its status and dignity; a warm interest in the furtherance of exploration, survey and charting of lesser known regions; the making of adequate monographs of restricted areas or topics and the publication of this high class work under conditions calculated to insure scientific and literary value; and if then with a right association of interests consequent wide distribution of published records be assured, we shall indeed have taken a long stride in advance toward a healthy establishment of geography, as a coherent body of interests, on the high plane it occupies in some of the countries abroad.

Such an organization as Professor Russell suggests will make all this growth possible. It is a far-sighted plan, too, to make the association wide enough to include both Americas. For if we include Mexico and the rest of Middle America we could have no good reason for barring the remoter parts of Latin America. There is a growing bond of interest between the various parts of the New World, a bond which every added year will strengthen more and more. It will be a wise plan to help this movement in every way; and here is an opportunity to create a common interest in a great subject in the whole of the western world.

To insure the high quality and standing of the Society, there is no doubt the qualification suggested by Professor Davis (Science, February 21, 1902) is essential. Let us have the first move made with care, and standards set so high that the dignity and authority of the Society will be at once established, and membership an honor and a privilege to be worked for. To this end the suggestion of Mr. J. Stanford Brown (Science, March 14, 1902) is pertinent, that is, let us have two classes of membership, one the active, voting members, who, by the way, may be called 'fellows,' and the other, the associate, or corresponding members.

The dues may be so assessed as to assure the quality of the publication, and the form of association with local societies may be so arranged that a slight addition to the local dues will make the local member an associate of the general society, and permit him to receive its publications at a reduced rate.

If the monthly magazine be kept at the high standard which we wish to see, it will be possible to have a salaried editor with training such as to assure the success of the magazine, and if the high standard be maintained, it will not seriously interfere with the local journals. There will be an audience for each quality.

As to the title, perhaps it will be permissible to make a different arrangement of the words which are necessary to properly describe the Society—for instance, the Geographical Society of America. But whatever the title, the idea is right, and the time is ripe, and if Professors Russell and Davis will take the lead, we shall yet have a general society in working order in time to welcome the International Congress in 1904.

J. PAUL GOODE.

UNIVERSITY OF PENNSYLVANIA.

THE WORD 'ECOLOGY.'

TO THE EDITOR OF SCIENCE: It is a good example of the well-known fact that the dictionaries—even the best of them—do not quite keep up with the progress of the language, which Mr. White has found in his search for the word 'ecology' (SCIENCE, March 28, p. 511). In its older form—œcology—this word occurs in the 'Century' and 'Standard' and no doubt in the other dictionaries referred to. The word was formally brought to the attention of American botanists in the Madison Botanical Congress, held in Madison, Wis., August 23 and 24, 1893, where the anglicized spelling was recommended and adopted. This action was in accordance with the well-known usage which drops the *o* in similar words, as in *economy* (instead of the older *œconomy*), *ecumenical* (*œcumenical*), *edema* (*œdema*), etc. The word ecology has been in quite general use in the botanical world for the past eight years, and in its older form it has been known in certain German biological works for at least a quarter of a century. It appears indeed that Ernst Haeckel first used the word, in his 'Generelle Morphologie,' as long ago as 1866.

CHARLES E. BESSEY.

LINCOLN NEBR.,
March 31, 1902.

IT is stated by a correspondent in a recent issue of SCIENCE that the word 'ecology' is not in the dictionaries. The word 'œcology' will, however, be found, so spelled in accordance with its etymology. It is only after words become universally known that these diphthongs are dropped, *e. g.*, paleontology, but we still have æsthetics, archæology, etc. I took pains, however, to have 'ecology' put in the Supplement to Webster; with a cross reference to 'œcology.'

LESTER F. WARD.

TO THE EDITOR OF SCIENCE: In the issue of SCIENCE for March 28, you ask for information respecting the word ecology. Under the guise of œcology, it is in quite common use among biologists, and is in fact used by many as a substitute for biology or rather a special phase of it. For example, what is called by many the biology of insects is called by others the œcology or ecology. Œcology and œcological can be found in any recent dictionary; ecology and ecological are the same words with the substitution of *e* for *œ* in accordance with analogy exemplified by economy, economical, etc., which were formerly spelled œconomy, œconomical, etc. The words in their new guise will appear in the supplement to the 'Standard Dictionary.'

THEO. GILL.

COSMOS CLUB,
March 28, 1902.

TO THE EDITOR OF SCIENCE: In reply to your inquiry in SCIENCE of March 28 (page 511) concerning the word ecology, it is to be said that the word occurs in the 'Century Dictionary,' but spelled œcology. It was coined by Haeckel in 1866 (in his 'Generelle Morphologie der Organismen'), but has come into general use only within the past few years. In Germany it is still spelled Œkologie, but in this country it is always ecology. It signifies the science of the adaptation of organisms to their surroundings, a field of study in which botanists have been more active than zoologists. Ecology is prominent in every elementary botanical text-book published recently in this country, and every schoolboy if taught by a modern teacher, knows something of it.

W. F. Ganong.

Northampton, Mass.,
March 29, 1902.

The dictionaries are well acquainted with *œcology,* but have not yet discovered the change to *ecology.* This is clearly an oversight, for they are usually glad to aid in the improvement of spelling.

G. K. Gilbert.

[Many other letters have been received pointing out that the word 'œcology' is to be found in the dictionaries. If it did not occur to our correspondent, who is the editor of the New York *Evening Post,* that 'ecology' should be looked up under 'œcology,' it would not to others unacquainted with the term or its etymology; and he appears to have supported his main contention, which was that technical terminology is a serious difficulty in the way of reading scientific literature by those who are not experts in the given science.—Editor.]

CURRENT NOTES ON METEOROLOGY.

FOG IN SWITZERLAND.

As a thesis for the degree of Ph.D. at the University of Bern, Gotfried Streun has published an elaborate report on the fogs of Switzerland (4to, Zurich, 1901). The observations used as a basis for this study were made in 1897 and 1898, and the work was carried on under the supervision of Professor Brückner and of Dr. Billwiller. The lowlands have a maximum of fog in the morning, as a result of the nocturnal cooling of the lower atmosphere, while the mountain summits show a comparatively uniform distribution of fog through the day. A weak afternoon maximum at the latter stations is due to the formation of cumulus clouds in the ascending valley winds. The annual period of fogs is well marked in the lowlands and lower valleys, where there are autumn and winter maxima, but on the mountain summits there is hardly any trace of annual periodicity. As regards the average duration of spells of foggy weather, it appears that single days with fog occur most frequently at the lower levels, where the periods of greatest length come in fall and winter. On the Säntis the longest periods of fog come in spring and summer. At these altitudes continuous fogs frequently last for more than twenty days, while on the lowlands a fog of eight days' duration is a rarity. The general weather conditions under which lowland fogs are formed in winter are distinctly anticyclonic, while those accompanying high-level fogs are distinctly cyclonic, in both summer and winter. In connection with his study of the conditions of fog occurrence, the author finds confirmation of the Hann theory of cyclones. Numerous charts accompany this monograph. They show the frequency of foggy days, and the occurrence of fogs during a remarkable foggy spell from October 26 to November 25, 1897. The effect of topography on the development of fogs is strikingly brought out by these charts.

HAIL PREVENTION.

In the Report of the Chief of the Weather Bureau for 1901 (Annual Reports, Department of Agriculture) Professor W. L. Moore makes a protest against the spread in the United States of the popular delusion that destructive hail storms can be successfully prevented by cannon-firing. Some little time ago Drs. Pernter and Trabert, the well-known meteorologists of the Vienna Observatory, were invited by the Austrian Department of Agriculture, and by the inventor of one of the methods of cannonading, to study the conditions and results of the bombardment on the ground. The investigation which was carried out was as complete as it was possible to make it, and the sum and substance of the report was that nothing positive could be said as to the value of the shooting. Scientific men who cannot visit the scene of the cannonading themselves, and who need any authority for their doubt as to the efficacy of the 'hail shooting,' may safely accept the conclusions reached by Pernter and Trabert.

NOTES.

AN article on 'The Making of Australia,' in the *Scottish Geographical Magazine* for March recalls the fact that in the early days of exploration in the interior of Australia the discovery of an inland sea was reported. The news was naturally hailed with delight, but further exploration soon showed that no such sea existed. The deception had been caused by a mirage.

FOR November and December, 1901, the *Monthly Bulletin* of the Philippine Weather Bureau appears for the first time in English as well as in Spanish. In the December number there is an account of the earthquake of December 15 at Manila, with a facsimile (natural size) of the curves traced by the Cecchi seismograph.

THE Weather Bureau has recently issued a new edition of its 'Instructions for Voluntary Observers.' This useful pamphlet contains instructions for the erection, use and care of maximum and minimum thermometers and of the rain-gauge; instructions regarding the keeping of records, and a brief discussion of the proper uses of several terms which are often misused, *e. g.*, hurricane, tornado, whirlwind, etc.

A SECOND edition of Eliot's valuable 'Handbook of Cyclonic Storms in the Bay of Bengal,' embodying all the latest results, has been published. The first edition was dated 1890.

R. DEC. WARD.

HARVARD UNIVERSITY.

JOHANN VON RADINGER.

THE obituary notices of Johann von Radinger, who died November 20, 1901, are appearing in the European scientific journals.

Radinger was born July 30, 1842, in Vienna. His education was secured at the Technischen Hochschule, where he became assistant to Professor von Burg before completing his course, and, later, 1867, adjunct to Professor Grimm von Grimburg. He was promoted in 1876, and was made Professor des Maschinenbaues in 1879. In 1891 he was the Director of that great school of engineering, and at his death, his record within its walls extended over a period of thirty-four years. In 1895 he was made President of the Osterreichischen Ingenieur and Architektenvereines.

In all this long professional and scientific career, Radinger exhibited talent, even original genius, industry and great power of achievement. But his spirit was of that lofty and broad and clear-sighted character which, as in the case of nearly every man of genius, while splendidly working in a chosen vocation, could still find opportunity and strength for those avocations which attract all men of mind. He was interested in art, in literature and in all the sciences. He kept himself abreast modern progress in all these departments of human activity. He even found time to do some purely literary work, and his dramatic poem, 'Das Weib des Polykrates,' was produced under most trying circumstances. His genius was recognized by both state and private honors. The Order of the Iron Crown was conferred upon this engineer and man of science as the highest tribute the government could pay to his merits as a man and a public-spirited citizen.

He combined, as do so many men of his profession, practical knowledge and high attainments in applied science with an intimate acquaintance with the pure sciences. He found occupation for a time with Cail at Paris in practical manufactures and, as Konstrukteur, himself directed important interprises. He performed his full share of the great work of his time in the reduction of the art of machine-construction to a scientific system. He was particularly fruitful of good work in the development of the theory and the scientific method of design and construction of details of mechanism, interesting himself particularly in the great work of his generation of making the heat-engine, and especially the steam-engine, an embodiment of the theory and the art, in applied thermodynamics and in applied mechanics. He was a successful leader in the substitution of the exact methods of science in these fields for the old 'rule-of-thumb' ways, in the conversion of the vocation of engineering into a profession demanding learning as well as experience.

Largely under his energetic direction, the legal enactments of the empire for the provision of safeguards in the operation of steam-engines and boilers took correct form and he was appointed to important positions under the laws enacted to secure their proper enforcement. He taught his classes and he taught his public with equal fruitfulness and zeal. He was a teacher of the most admirable sort, exact, clear-sighted, endowed with that imagination without which no teacher can instruct and no investigator can either advance or help others to advance in research, friendly and patient, ambitious and aggressive, enduring and persevering, a leader always in the front rank and always beckoning from the van, never pushing his men on from the rear. He accomplished a notable life's work as instructor, investigator and author.

In personality, Radinger was interesting, attractive and impressive. The writer, as colleague on the International Juries at Vienna and at Philadelphia, 1873–1876, became greatly interested in the quiet, yet earnest and enthusiastic, scholar, philosopher and teacher. Inquiring into every detail of the, to him, astonishingly numerous wonders of invention and construction in the 'Yankee sections'; noting each device, its form, proportions and special construction and finish with the greatest care; comparing its dimensions with its work and the relation thus established by its designer with that usual in his own country; studying the methods of piece-work and of manufacture by production of interchangeable parts; excited over the marvelous watchmaking illustrated at the Centennial, or, after the jury had adjourned for the day, wandering in the art galleries and the halls of sculpture, or into the exhibits of the great publishers in search of interesting text or fine bindings, the broad grasp and unbounded intellect of the man were always revealed.

He was one of those generous men who, at the Vienna exposition, admitted the right of George Corliss to the 'Ehren Diplom,' although not a steam-engine of his make was exhibited. Radinger, von Grimburg, Reuleaux, Tresca, Dwelshauvers, Hartig, Schneider of Creusot, and a few others, advocated the highest award to the great American inventor, as they agreed, on the ground that the proof of his genius and of his enormous usefulness to the world was to be found in every section in the whole exhibition; every section contained one Corliss engine, and often several exhibits illustrated the work of the great mechanic.

The teacher, the man of science, the man of affairs, the investigator and author, the noble, kindly, generous and judicial man, will dwell in the memories of all who knew him and will be mourned by his colleagues and his friends as long as they live. His works will long remain, monuments to his life, his labors and his achievements. R. H. Thurston.

SCIENTIFIC NOTES AND NEWS.

The spring meeting of the Council of the American Association for the Advancement of Science will be held on Thursday afternoon, April 17, in the Assembly Hall, Cosmos Club, Washington, D. C.

Dr. Alexander Agassiz, who is now in Europe after his expedition to the Maldive Islands in the Indian Ocean, will return in time to preside at the meeting of the National Academy of Sciences which will be held at Washington next week.

Dr. James E. Russell, dean of Teachers College, Columbia University, has returned from a tour of inspection of the school system of Porto Rico, made at the invitation of the Porto Rican government.

Last year the Misses Caroline and Olivia Phelps Stokes placed in the custody of the New York Botanical Garden the sum of $3,000, the interest to be employed in efforts to preserve our native flora. The income for the current year was disposed of in the form of three competitive prizes, of $50, $30 and $20 respectively, for the best essays on this subject. The first of these prizes has just been awarded to Dr. F. H. Knowlton, editor of *The Plant World*. Dr. Knowlton's essay is printed in the March number of the *Journal* of the New York Botanical Garden.

MR. SHERBURNE W. BURNHAM, clerk of the U. S. Circuit Court since 1892, has resigned his position to devote his time to astronomy. Mr. Burnham was senior astronomer at the Lick Observatory in California when he accepted the Federal court clerkship.

DR. W. F. DREYFUS, assistant in chemistry in Columbia University, has been appointed chemist to the Department of Public Charities in New York City.

DR. LEONIDAS H. LAIDLEY, of St. Louis, has been appointed medical director of the St. Louis World's Fair.

PROFESSOR VIRCHOW'S health is said to be quite satisfactory. The fracture of the femur has united, and he gets up every day, but it will be some time before he will be able to resume his university work.

M. SANTOS-DUMONT, the Brazilian aeronaut, is a passenger on the *Deutschland*, due to arrive this week in New York.

PROFESSOR SAMUEL L. PENFIELD, of Yale University, will lecture on April 22 under the auspices of the department of geology of Columbia University on 'Possibilities in Geography resulting from the Revival of an Ancient Method of Map Making.'

THE portrait of Benjamin Franklin, executed by Gainsborough at the time of the signing of the Treaty of Paris, and lately given to the University of Pennsylvania by the class of 1852, has been hung in the University Library.

A MEMORIAL bronze tablet has been placed on the Albany (N. Y.) Academy in memory of Joseph Henry, stating that his experiments in electricity were made in that building while he was acting as professor of mathematics.

THE death is announced of Charles Letourneau, professor of the history of civilizations in the Paris School of Anthropology, secretary-general of the Paris Society of Anthropology, and a member of the commission for preserving the Megalithic Monuments of France. Among Professor Letourneau's many noteworthy works may be mentioned: 'La sociologie d'après l'ethnographie'; 'L'evolution de la morale'; 'L'evolution du mariage et de la famille'; 'L'evolution de la propriété'; 'L'evolution politique dans les diverses races humaines,' and 'L'evolution juridique dans les diverses races humaines.'

JOHN M. D. MEIKLEJOHN, professor of the theory, history and practice of education at the University of St. Andrew's, is dead. He was the author of many works, including a translation of Kant's 'Critique of Pure Reason.'

THE British National Physical Laboratory was formally opened on March 19. Sir William Huggins, president of the Royal Society, presided, and addresses were made by the Prince of Wales, Lord Rayleigh, Lord Kelvin and others.

THE Dudley Observatory at Albany, N. Y., recently celebrated its fiftieth anniversary, an address being made on the occasion by Mr. Lewis Boss.

A CABLEGRAM has been received at San Francisco, stating that the U. S. Fish Commission steamship *Albatross* arrived in Honolulu on March 24. The vessel is under command of Commander Chauncey Thomas, U. S. Navy, and has on board Dr. C. H. Gilbert, J. C. Snyder, and W. K. Fisher, of Stanford University, and Professor Nutting, of the University of Iowa, who will make a collection of fishes and marine vegetation. Very rough weather was encountered on the trip. The *Albatross* spent several days dredging and sounding. She will remain in port about six days, and then continue her exploring expedition around the different islands.

MR. ZENAS CRANE, of Dalton, Mass., has announced his intention to give Berkshire County a Museum of Natural History and Art. The building will cost $40,000, and Mr. Crane will give his collection of natural history and works of art, valued at $20,000.

MR. ANDREW CARNEGIE has offered to erect a public library at Havana at a cost of $250,000 on his usual conditions. The municipal council has voted to send a letter to Mr. Carnegie saying that it had been informed that he would give Havana this sum for a public library, provided that the city would give land for the building and guarantee $25,000 a year for improvements and the maintenance of the library. The letter will also say that the council has decided to give a site for the proposed library, and that it accepts the provisions attached to the gift, but that the law does not allow it to bind the action of future municipal councils in matters of this kind.

The Blue Hill Meteorological Observatory is being enlarged, at a cost of five thousand dollars, by the construction of a fire-proof library, which will contain Mr. A. L. Rotch's valuable and rapidly increasing collection of books, pamphlets and periodicals relating to all branches of meteorology.

The Goldsmiths' Company will commemorate the coronation of King Edward by contributing £5,000 to the fund of £130,000 needed for the plan being elaborated by the conjoint board of the Royal Colleges of Physicians and Surgeons for investigating the causes, prevention, and treatment of cancer. Mr. H. L. Bischoffsheim has offered to contribute £5,000 to the fund, and another donation of the same amount, as well as other smaller sums, have been promised.

The Government of Queensland has offered a reward of $25,000 for the invention of some satisfactory means for destroying the 'prickly pear.'

At the (1900) Annual Meeting of the Society for the Promotion of Agricultural Science it was decided to elect the officers by the postal system. Each member should nominate persons to fill the offices, which are: president, secretary-treasurer, one member of the executive committe. Members are also requested to nominate candidates for membership, with full reference to valuable work performed, and, if possible, secure testimonials from other members. The next meeting will be held at Pittsburg, Pa., in conjunction with the American Association for the Advancement of Science; the first session will be called at 3 o'clock p. m. on Monday, June 30, 1902. Replies should be addressed to the President, Professor W. H. Jordan, Geneva, N. Y.

The New York University Chemical Society has recently been organized by the students, with Edward T. Hendee, 1900, *President;* Arthur E. Hill, 1901, *Vice-President;* and Franklin D. Byxbee, 1902, *Secretary and Treasurer.*

At the monthly general meeting of the Zoological Society of London on March 20, Dr. R. Broom, Dr. Carl Chun, M. Philippe Dautzenberg, Colonel Brian Mahon, C.B., D.S.O., and Dr. A. Donaldson Smith were elected corresponding members. It was stated that there had been 73 additions made to the society's menagerie during the month of February, amongst which special attention was directed to a fine young male snow leopard from Ladakh, presented by Captain H. I. Nicholl, and to a pair of Prjevalsky's horses from Western Mongolia, received on approval and new to the Society's collection.

It is reported from Washington that the plan which started at the beginning of the present session of Congress as a proposal that the president should recommend, and congress create, a department of industries, seems to have been revived within a little while in another form. The department of commerce is in a fair way to become an accomplished fact; and in the course of procuring the necessary legislation for it, there has been shown a desire on the part of many of the scientific experts in the government's employ to have their bureaus grouped, instead of being scattered through several departments. There will be an effort to attach to the department of commerce act a clause giving the president authority to transfer from other parts of the service to the Department of Agriculture such scientific bureaus as appear to his satisfaction to be cognate to the work of this department. If this is not done, it may be attempted to attach a paragraph authorizing a commission, consisting of one senator and one representative, and possibly three scientific experts, to look into the question of grouping the scientific bureaus in the manner indicated; the report of the commission to furnish a basis for further legislation.

The third annual report of the Liverpool

School of Tropical Medicine has been issued. The despatch of Major Ross to Sierra Leone brings up the number of expeditions sent out by the school for purposes of medical research and sanitary measures in the tropics to eight. Among the students trained at the school in the past year were medical men from Canada, India, East Africa, Penang, Sierra Leone, Uganda, Germany, Belgium and Sweden. More than 130 cases of tropical diseases were treated at the school.

IT appears that Germany has determined to regard in the light of a 'present' from the Chinese government the astronomical instruments stolen by her soldiers from the Chinese observatory at Pekin. This view was set forth by Count von Bülow, the imperial German chancellor, in a speech delivered in the German Reichstag, a copy of which has been received in Washington. Count von Bülow said: "The instruments have not been restored because the Chinese government attaches no importance to their possession, and in reply to German inquiries it placed them at the disposition of the German government. Another consideration is that, in accordance with the peculiar views of the Chinese, the great mass of that people would have supposed that the instruments were restored by order of the Chinese government, which would have damaged German prestige in East Asia. The Dowager Empress of China, a very clever woman who understands the political situation, would have been distinctly offended, while the masses would have thought that Germany had sustained some terrible defeats. The instruments ought now to be placed in the category of presents from government to government, which has long been customary on both sides in the intercourse with the Chinese government."

MR. STEVENS sold recently in London the collection of British lepidoptera formed by the late Mr. Philip Crowley. Among the more important lots were nine specimens of *Dispar*, or large copper, the now extinct British butterfly. These averaged £5 apiece, one female realizing £7. An assortment of exotic butterflies also realized good prices.

THE London *Times* says: There is on view in the library of the Royal Institution, an exhibit of the artificial dye stuffs produced by the Badische Anilin und Soda Fabrik, together with specimens of a great number of fabrics and materials, from silk to sealing-wax, to which they can be applied. Those who are interested in the bearing of technical progress abroad upon British industry will note the extraordinary range of colors produced from raw materials which are abundant in this country and of which English chemists first discovered the value. They will be not less painfully impressed by the excellence and variety of the artificial indigo dyes, the production of which now equals one fifth of the world's consumption and constitutes a very pressing danger for a great Indian industry.

IT is said that after prolonged experiments in sending four telegraphic messages each way simultaneously over a single wire, the German postal department has accepted the octuple transmitter invented by the late Professor Henry A. Rowland, of the Johns Hopkins University. The experiments were conducted between Berlin and Hamburg. Between 300 and 350 words were transmitted a minute. It is understood that the German postal department intends to introduce the Rowland system between Berlin, Hamburg, Cologne, Leipzig and Frankfort.

UNIVERSITY AND EDUCATIONAL NEWS.

THE daily papers have reported the remarkable bequest of the late Cecil Rhodes for education and the promotion of a good understanding between Great Britain, Germany and the United States. It appears that Mr. Rhodes has provided two scholarships for each state and territory of the United States and from each British colony, and for fifteen from Germany, the students to study at Oxford. The amount of the bequest is reported to be about $10,000,000, and the value of each scholarship about $1,500, but this appears to be uncertain. Mr. Rhodes also left £100,000 to Oriel College, Oxford.

Senator George F. Hoar, president of the board of trustees of Clark University, has made an announcement stating that Mr. Clark's will is absolutely settled, and that the income of the whole bequest, amounting to $2,600,000 will, in a few months, be at the disposal of the trustees, with the exception of $400,000 and the estate on Elm street, which Mrs. Clark holds for life. The sum of $500,000 has already been paid over to start the collegiate department.

Teachers College, Columbia University, has received an anonymous gift of $250,000 for the erection of a gymnasium.

An assembly hall to cost $50,000 will be erected at Haverford College by Mrs. Charles Roberts, in memory of her late husband, who was an alumnus and for thirty years a member of the board of managers of the college. She will also present to the institution Mr. Roberts's collection of autographs, valued at $50,000.

Two anonymous gifts, one of $5,000, another of $10,000, have recently been made for the new medical laboratories of the University of Pennsylvania.

Mayor Low has approved the bill providing for pensioning the supervising officers and teachers of the College of the City of New York. The amount to be set aside each year is 1 per cent. of the excise fund, or about $50,000.

The building which has been in process of erection for some years past in the front square of Trinity College, Dublin, will be formally opened on May 30. The new building occupies one side of the square, and among other uses will accommodate the historical and philosophical societies and will provide a meeting place for graduates of the university. Of the total cost of the memorial the sum of £8,500 was subscribed by the graduates.

The court of governors of the University College of Wales, Aberystwith, have decided to extend the chemistry department at a cost of about £5,500 and to call a joint conference of college and county authorities with the view of establishing an experimental farm. Upon the question of a national museum for Wales, the governors decided that, having regard to the geographical and educational conditions of the principality, the objects in view would be best served by grants to libraries or museums of a national character in the three centers of university education in Wales.

Senator Deboe, chairman of the Senate committee to establish the University of the United States, submitted on April 1 an affirmative report on behalf of that committee on the bill to establish a National University. The bill is the one introduced by the chairman and differs from those introduced by Senators Depew and Wellington chiefly in that it lessens the number of regents and raises the standard of admission for students in the field of general studies so that they must already have such attainments as represented by the degree of master of arts, instead of bachelor, as under the other bills.

Announcement has now been made of the official program on the occasion of the installation of Dr. Nicholas Murray Butler, as president of Columbia University, on April 19. The ceremonies will begin at 2:30 p.m. An address will be made by the chairman of the trustees, who will present the keys and charter of the university and the president will respond. There will then be addresses on behalf of the faculties by Dean Van Amringe; on behalf of the alumni by Mr. R. Fulton Cutting, and on behalf of the students by A. B. A. Bradley, followed by addresses by President Eliot, of Harvard; President Hadley, of Yale; President Patton, of Princeton; President Harper, of Chicago; President Draper, of Illinois, and Commissioner Harris. President Butler will then deliver the inaugural address. In the morning there will be a reception to the guests, numbering over three hundred college presidents and professors, and the buildings will be open for inspection. There will be a luncheon in University Hall, and in the evening a dinner will be given to President Butler, at which President Roosevelt, Mayor Low and others will speak.

Dr. Frederick W. Colgrove has resigned the professorship of philosophy in the University of Washington, being seriously ill.

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, APRIL 18, 1902.

CONTENTS:

*PLANT PATHOLOGY: A RETROSPECT AND PROSPECT.**

THE study of plant diseases has made remarkable progress within the last two decades. This is commented upon at home and abroad. Perhaps in no field outside of organic chemistry or of animal pathology and bacteriology have the advances been greater. In casting about for a subject, it has seemed to the speaker therefore that perhaps he could not do better in the time allotted to the presidential address than to consider, first, the state of plant pathology prior to the year 1880; second, the progress which has been made from that time to the present; and, third, some of the problems which now confront the investigator. Nothing beyond a popular sketch is contemplated.

The twenty years preceding 1880 were years of stress and uncertainty in the biological world. Pasteur and Cohn had laid the foundations of modern bacteriology and the whole world was agog with interest over the new doctrines of fermentation and of disease. Sachs and de Bary had done equally magnificent work in plant morphology and physiology. But the great masters were not having everything their own way. Hallier and Billroth in Germany were upholding a crazy doctrine of

* Presidential address before the Society for Plant Morphology and Physiology, Fifth Annual Meeting, New York, January 1, 1902.

the polymorphism of species whereby an organism could change into, practically, whatever happened to grow in its vicinity; while Pouchet in France and Bastian in England were maintaining the spontaneous generation of minute organisms in sterile liquids with great vigor and a considerable following, if not with much logic. Everywhere the old, well-intrenched theories of disease were in conflict with the new. During the whole of this period the doctrines of Darwin were opposed and fought over with a pertinacity and a rancor scarcely to be appreciated by the younger men of this generation. Evolution has now become our watchword, but even yet we do not fully appreciate what it means, or at least we often speak and write as if we did not. It is too large a thought, and we are still entangled in the language of our ancestors. Especially do we not fully appreciate the molding influence of environment, *i. e.*, the plastic nature of the living organism under the action of changed conditions.

Prior to the year 1880, laboratory methods for the study of fungi and bacteria were not well developed. In the first place, there was no exact and convenient method for obtaining pure cultures and, in the second place, the microscope was still the principal instrument of research. The few experiment stations in this country and those in Europe were, for the most part, plodding along in a perfunctory way, without good equipments and with little money for botanical inquiry, and the study of plant diseases was scarcely thought of outside of a few university laboratories, and rarely in these with anything practical in mind for the benefit of agriculture. The main thing considered was the parasite rather than the host plant, and the technique for the study of both was of the simplest sort. We had no precise fixing and staining methods, no fine microtomes with their yards of serial sections, no synthetic culture media, no elaborate sterilizing ovens and brood chambers, and no apochromatic glass for lenses. 'Pure cultures' were practically unknown, and photography and photomicrography had not yet become arts of daily use in the laboratory.

Prior to 1880 we had indeed the brilliant researches of Louis Pasteur on a variety of subjects of wide interest to biologists, if not bearing directly on plant pathology. Berkeley had already done some good work on plant diseases in England, although most of his efforts had been devoted to systematic mycology. Tyndall in England had also done much to clear away the fog produced in the public mind by the adherents to the doctrine of spontaneous generation. Kühn, Sorauer, Frank and Hartig had begun their studies in Germany. But it was especially to de Bary, in Germany, that all eyes were turned as the great master mind. He had published a series of brilliant papers on the life history of various fungi, and was stimulating many of the younger men to undertake a higher type of research work than was then in vogue. Among these men, Woronin deserves especial mention. He published several fine papers in conjunction with de Bary and has continued the good work independently. In our own country, Dr. Farlow had published a number of interesting papers from the Bussey Institution on black knot and other diseases of plants, and there was some mycological work with an economic aspect going on under Dr. Burrill's direction at the University of Illinois, and under Dr. Bessey's direction at Ames, Iowa. In Europe and America, a number of younger men, who have since become widely known, were just beginning their work on diseases of plants.

Plant pathology was not an attractive profession in those days. When he first desired to make the diseases of plants, or mycology, as we called it, his chosen profession, the speaker well remembers casting his eye over the field very dubiously. There were no places for such workers, and, from the pecuniary side, it was a barren and unsatisfactory prospect. Nevertheless, the field was so inviting in other ways that it appeared to be worth while to run the chances. A meager livelihood in the pursuit of a most attractive line of work seemed preferable to a mint of money earned in an irksome profession, and so the die was cast.

How changed is the present outlook! At present, and for some time to come, the demand for well-trained plant pathologists (in this country, at least) is likely to be considerably in excess of the supply. By this I do not mean that there are not already enough, and more than enough, of second and third-rate workers; and I would not advise any one to enter the field who has not a marked talent for this line of inquiry, robust health, good training, and a determination to do superior work.

Of course, the magnificent development of bacteriology and animal pathology within the last twenty-five years has had its influence upon the study of plant pathology, as it has had upon all related sciences, but it does not seem to have exerted as great an influence or as immediate an influence as one would have supposed. In general, botanists were the ones upon whom the investigation of plant diseases naturally devolved, and most of them for some reason were very slow to make use of the exact methods of research which have led to such brilliant results in the study of human and animal diseases. However, as time has passed, more and more men have learned how to study plant diseases, and a considerable body of plant pathologists, although by no means all, are no longer open to the charge of not knowing how to pursue pathological researches.

Inasmuch as we have always had plant diseases with us, the query is sometimes raised why it is that the exact study of such diseases was postponed until the end of the nineteenth century. The primary reason, no doubt, is that exemplified over and over again in the history of the world, viz., that one branch of research must often wait for the development of some other branch. In this case, inquiry into the causes of many diseases had to wait for an exact method of isolation of the parasites and a knowledge of how to grow them in pure cultures. It now seems to us a very simple matter to separate one organism from another by means of poured gelatin or agar plate cultures. It seems, also, a very near discovery that discontinuous sterilization for a short time on three successive days should render a culture medium sterile, and that the simple intervention of a sterile cotton plug between this medium and the open air should suffice to strain out all the floating organisms of the air and keep the medium indefinitely sterile. That the study of the causes of certain diseases should have to wait many years until these simple facts had been demonstrated and a knowledge of them diffused among men is not less true than it is remarkable. The whole science of bacteriology and all the wonderful advances that have been made in the etiology of obscure diseases really date from the time when we were first able, with some degree of ease and exactness, to separate out one kind of organism from another and grow it indefinitely in pure cultures, all of which has come to pass since the year 1880. Only the crude beginnings of bacteriology were earlier than 1880. Prior to that time we had, it is true, the fractional and dilution methods of isolation, but these, although capable of yielding good results, are troublesome and have never appealed very strongly to the mass of workers.

In the time of which I speak, there were already many excellent helps in the way of treatises on fungi. We had, for instance, the splendid volumes of the 'Selecta Fungorum Carpologia' by the brothers Tulasne, and if we were not always sure of the Latin construction, we could at least read the magnificent copper plates which embellish these volumes. There were also books by Persoon, Corda, the Nees von Essenbecks, de Notaris, Rabenhorst, de Schweinitz, Fuckel, Bonorden and Montagne. There were numerous volumes by the Swedish mycologist Frieze. We had also Berkeley's 'Outlines,' Cook's 'Handbook of British Fungi,' and many scattered descriptions by Oudemans, Magnus, Schroeter, Winter, Berkeley, Cook, Ellis, de Thuemen, Rehm and others, in *Hedwigia* and other journals. The Italian Saccardo had not yet begun his monumental compilation of all known species of fungi, but he was printing the first parts of his 'Fungi Italici.' Several parts of Brefeld's 'Untersuchungen' also appeared prior to 1880, and there was an excellent 'Handbuch' of cryptogamic plants by Luerssen. There were also some good exsiccati, including, in this country, the first centuries by Ellis. De Bary's 'Comparative Morphology and Biology of the Fungi,' and the splendid cryptogamic 'Floras' by Winter, by Schroeter and by Oudemans had not yet appeared.

In the matter of plant diseases, we were much less well provided. In fact, there was scarcely anything in English in the nature of a general treatise. The nearest approach I can recall was a brief chapter on diseases caused by fungi in Berkeley's 'Outlines of British Fungology' (1860), and a little book by M. C. Cook entitled 'Rust, Smut, Mildew and Mould' (1865). A knowledge of foreign languages was even more essential in that day than it is now for the study of diseases of plants. Even in European tongues there were comparatively few useful general works on diseases of plants. We had, it is true, the rare, largely neglected, and generally negligible, crude, early works of Re, Unger, Meyen, Hamel and Hallier. There was also the first edition of Sorauer's 'Pflanzenkrankheiten' (1874), and Winter's little book of a dozen chapters, which appeared in 1878. This book, which described some of the commonest diseases of plants, is now quaint and old-fashioned reading, but it then seemed a model in its way. In 1878 there also appeared a little book by de Jubainville and Vesque on 'Les Maladies des plantes cultivées, des arbres fruitièrs et forestièrs, produites par le sol,—l'atmosphere,—les parasites végétaux, etc., d'après les travaux de Tulasne, de Bary, Berkeley, Hartig, Sorauer, etc.' There was also an earlier and very good book for its time by Kühn (1858).

A few diseases had been worked up quite carefully as to their etiology, and in the doing of this the way was blazed for the critical study of other and different diseases, and also, of course, for a great deal of inference and uncertain speculation. I refer to de Bary's classical work on the potato rot fungus (*Phytophthora infestans*), Farlow's work on the mildew of the grape (*Peronospora infestans*) and the black knot of the plum and cherry (*Plowrightia morbosa*), Woronin's work on the club root of the cabbage (*Plasmodiophora brassicæ*), de Bary's discoveries with reference to the heterocism of the grain rust (*Puccinia graminis*), Cornu's studies of the *Phylloxera* of the vine, Fischer von Waldheim's studies of certain of the grain smuts, and similar papers. The rusts and smuts, and the downy and powdery mildews, were the best-known parasites. Certain fungi then supposed to be pure saprophytes are now known to be active parasites, *e. g.*, certain members of the form-genus *Alternaria* and of the form-genus *Fusarium.*

Very little was known relative to the treatment of plant diseases beyond the fact that mildews in hothouses were supposed to be induced by draughts of cold air and to be partially preventable by the use of sulphur dust; that wheat smut appeared to be partially controllable by soaking the seed-wheat in a solution of copper sulphate, and that sulphur dust was a remedy for *Oidium* of the vine.

Little or nothing was known with regard to varietal or individual resistance of plants. In a general way, it had been observed by many that, under what seemed identical conditions, some plants sickened while others remained healthy, but it was quite generally believed that this was due to the fact that there had been no good opportunity for the fungus to infect the plant, rather than that the plant itself had any special power of resistance. This idea was yet unborn, or, at least, had not come to any prominence among pathologists.

Among the great mass of farmers and other growers of plants, the rusts, smuts, mildews, etc., were accepted as the will of God, or as a matter of course, and it never entered their heads that anything could be done to lessen the ravages of these troubles.

Nothing whatever was known about bacteria as the cause of plant diseases except to two or three workers who were just beginning their studies in this field. I refer especially to Burrill in America and Prillieux in France. It was also not generally recognized that algæ could cause disease in plants. Little or nothing was know about enzymes, ions, cell nuclei or symbiosis as important factors in plant life.

Let us now for a few minutes glance at what has been accomplished in the last twenty years. From being a mere rule of thumb, plant pathology has become a well-established branch of botanical science, the study of which has been pursued in many places with astonishing ardor and excellent results. Among others, the following authors have published general works on plant diseases within the period named: Sorauer, Frank, Hartig, W. G. Smith, Kirchner, Scribner, Ward, Comes, Prillieux, von Tubeuf, Massee. Sorauer, Frank, Hartig and Ward have published several different books on plant diseases. Books by Hartig and von Tubeuf have been translated into English, and Kirchner's book has recently been done into Italian. In some cases elaborate treatises have been written on the diseases of small groups of plants, *e. g.,* Viala's 'Diseases of the Vine' (three editions), and Erickson's 'Grain Rusts.' Sorauer and Kirchner have also both published atlases of plant diseases, illustrating the more common diseases with colored figures, which, however, in many cases, it must be confessed, could be improved upon. In this enumeration the extremely useful 'Host Index' by Farlow and Seymour should not be forgotten, nor Sturgis' compact 'Bibliography.'

In the publication of authoritative general treatises on plant diseases, the United States has not kept pace with Germany. Scribner's little book on 'Fungous Diseases of the Grape, etc.' (1890), is all that I can recall. That no book at all comparable with the handbooks of Sorauer, Frank, Kirchner or von Tubeuf has yet appeared in the United States is a matter for some wonder, considering the number of us who are affected with an itch for writing. It is also a matter for regret, considering the extent of our territory, the number of our plant diseases, and the character of our population. There is now a demand in this country for several good manuals of phytopathology, and these books are the more to be desired because European manuals only very imperfectly outline American conditions. Who will be the first to enter the field with something really excellent? Surely we ought to expect something rather better than the books I have named. A special exhortation to do well is hereby extended to the first man to occupy the field, since, if he sets the standard high, all the others must rise to his level, and the general gain will be great.

As an illustration of the growth in the United States of this branch of science, I may be permitted to cite the fact that when the speaker entered the United States Department of Agriculture at Washington in 1886, this line of work had only recently been separated from the ordinary botanical work of the department, which then consisted principally of answers to correspondents, and species descriptions of grasses. At that period, and for some time to come, we had no laboratory facilities and scarcely any place we could call our own. A little cubbyhole was apportioned off for the chief, Professor Scribner, and his assistant was allowed, by courtesy of Dr. Marx, the department artist, to occupy a desk in his room. We had very few books, and nothing in the way of apparatus beyond the simplest sort of microscopes. Now, under direction of this same United States Department of Agriculture, we have several more or less well-equipped laboratories in Washington, one in California, one in Florida and one in the Middle West at St. Louis. The number of men employed, including those who are working with us in the closely related and frequently overlapping fields of plant physiology and plant breeding, and exclusive of clerks, typewriters, artists and laborers, is twenty-six. The amount of money appropriated by Congress for this line of work in 1887 was $5,000; the sum named as necessary in the estimates of the Secretary of Agriculture for the coming year is $118,000.

As to places for the study of plant diseases, we now have in this country about fifty experiment stations where such diseases are studied or may be studied, and perhaps half as many colleges and universities, where more or less attention is given to the subject. No great university has yet done itself the honor to establish a distinct chair of plant pathology, but the subject is such a large and important one that this must unquestionably follow within a few years. More attention should, I think, be given to the proper teaching of this subject in colleges and universities. While perhaps the study of plant diseases has had a larger development in this country than anywhere abroad, owing to the fostering care of the National Government, there are nevertheless many places in other parts of the world where such diseases are now studied. I might mention the dozen or more experiment stations in Italy, in nearly all of which something has been done on this subject; the numerous places in Germany, in universities and agricultural colleges, and now recently in the laboratory of the Imperial Government Board of Health, under the able leadership of Dr. von Tubeuf; similar places are now provided in France, England, Russia, The Netherlands, Sweden and other European countries, for the study of plant diseases. There is also considerable activity in Japan, in Australia, in Java and in various other parts of the world.

The result of this is that a large body of young men has undertaken the study of this class of diseases, and the literature of the subject is now extensive. It is also, unfortunately, so scattered through journals, transactions, agricultural papers, etc., that one must read very widely if he would undertake to keep pace with the advances which are being made. This, of course, has its great disadvantages, and one sometimes wishes that the Latin tongue had been retained as the universal language of science, or that some one language could be agreed upon in which the abstracts of all scientific papers should be published as a prerequisite to international recognition, or at the very least, that the authors of all important papers would follow the good example set by some of the Japanese and Russian writers. These men publish with their papers a summary in some other language. Such summaries need not be long. They should be, preferably, in English, German or French, since these are the leading scientific languages of the world, so far as quality and bulk of publication are concerned.

Of special journals devoted to plant pathology there were none twenty years ago; now there are five or six. Very many of the general journals of botany also now publish long papers on diseases of plants.

The time is too brief to cite all of the interesting special papers which have appeared during the last twenty years, even if it were desirable. I may, however, mention the following as interesting examples of what has been done at home and abroad. First, perhaps, in importance comes de Bary's pioneer paper on *Sclerotinia* and sclerotinial diseases. Hartig has published numerous very interesting papers on the diseases of trees and of timber. Woronin published a beautiful paper on *Tubercinia trientalis* and several equally interesting ones on sclerotinial diseases. Sadabeck and Johanson have added much to our knowledge of the *Taphrinas*. Frank has published several interesting communications on a *Gnomonia* disease of the cherry, in which he not only points out the cause of the disease, but also a remedy for the same. Burrill and those who followed him have worked out conclusively the etiology of pear blight. Savastano, Cavara and others have done the same for the olive knot. Many other diseases have also been shown to be due to specific bacteria, one of the best recent papers being by Jones, of Vermont, on a soft rot of the carrot and other plants. Brefeld has shown for many of the smuts that they can vegetate for long periods in forms resembling yeasts. In a magnificent paper on corn smut the same author has shown clearly that, unlike most smuts, the pustules appear in about fourteen days from the time of infection, and that only young, actively growing tissues can be infected. Ward in a remarkably fine paper showed a certain lily disease to be due to *Botrytis*. Woods has brought a whole class of diseases into prominence by demonstrating the spot disease of carnations to be due to insect punctures. Various workers have shown that insects and mollusks are frequently the indirect cause of disease by carrying bacteria and the spores of parasitic fungi from diseased to healthy plants. Galloway demonstrated the early blight of potatoes to be due to an *Alternaria*. Peglion in Italy proved a destructive spot disease of muskmelon to be due to another *Alternaria*. Dorsett has demonstrated that a third species causes the vexatious spot disease of violet leaves. Barclay, Plowright, Schroeter, Winter, Magnus, Klebahn, Dietel, von Tubeuf, Farlow, Thaxter, Carleton and Arthur have all contributed to our knowledge of those perplexing rusts which grow alternately on widely different plants. Erickson has demonstrated the existence on related plants of morphologically similar rusts which are incapable of cross-inoculation. Thaxter has shown that the potato scab is due to a minute fungus, *Oospora scabies*. Laurent has published two very interesting papers on the causes of immunity, one dealing with bacterial potato rots and the other with the distribution of the mistletoe in Belgium. W. G. Smith has published interesting papers on the histology of galls due to *Taphrina* and other fungi. Cornu published an interesting paper on the grape mildew (*Peronospora*). Nawaschin has increased our knowledge of the parasite which causes club root in cabbage. Went and Beyerinck have published a number of very suggestive papers on enzymes. As already stated, this list is not designed to be complete. It might be greatly extended.

A great advance has also been made in treatments for the prevention of disease. In France, Millardet saw that the mildew did not attack certain grape vines which had been sprinkled with a mixture of bluestone and lime to prevent thefts of the grape bunches. He had the alertness of mind to recognize that here was the germ of an important method of treatment, and, with the help of Gayon, promptly elaborated it for the prevention of mildew of the grape. Following fast on the heels of this discovery was its application in France, Italy and the United States for the prevention of other fungus diseases. By the General Government, under the energetic direction of Scribner, and subsequently of Galloway, and a little later by many experiment station workers and farmers, this and similar methods of treatment were applied successfully in the United States for the prevention of the black rot of the grape, leaf spot of the pear, apple scab, and a number of other serious diseases of plants. At one time this treatment was hailed as a general panacea for all plant diseases. In Denmark, Jensen discovered that smut of various grains could be prevented by soaking the seed in hot water for a few minutes. These experiments were subsequently repeated, expanded and confirmed in this country by Kellerman and Swingle. Thaxter and Sturgis demonstrated that onion smut was only communicable during the seedling stage of growth and that, if plants were grown for a few weeks in healthy soil, they might be transplanted to fields badly infested with this smut without danger of infection. Bolley showed that the potato scab was frequently disseminated by seed potatoes, and in such cases could be controlled very satisfactorily by soaking the infected seed potatoes in a solution of corrosive sublimate. This treament is, however, not successful in case the fungus is already present in the soil. Coquilette, the entomologist, demonstrated that certain scales infesting orange trees in California could be controlled by fumigating with hydrocyanic acid gas, and Woods and Dorsett in Washington subsequently extended this treatment and applied it on a large scale, most successfully, for the freeing of hot-house plants from scale insects and aphides. This treatment has subsequently been pretty generally applied in the United States for the fumigation of nursery stock. Riley and others conceived the idea that the best method of controlling certain scales would be by multiplying their insect parasites, and the threatened destruction of the orange orchards of California by the cottony cushion scale was avoided in this way, viz., by the introduction of a lady-beetle from Australia. Giard, Snow, Forbes and others have experimented with certain fungous parasites of crop-destroying insects, hoping to spread epidemics among them, but thus far with only partial success. The dreaded San José scale can now be held in check in this country by insecticidal sprays. Potter, Halsted and others have shown that club root of cabbage may be partially prevented by heavy liming of soils. Millardet, as a result of thousands of crosses of *Vitis vinifera* with hardy American species, has obtained wine grapes resistant to *Phylloxera*. Pierce, by similar methods, has obtained a raisin grape resistant to coulure. Quite recently the Dutch in Java have largely circumvented the Sereh disease of sugar cane by bringing healthy cuttings from the hills. Cobb pointed out a way to avoid the gumming of sugar cane, a serious disease in Australia, viz., by the selection of healthy cuttings. This practice, he informs me, has greatly reduced the amount of gummed cane in New South Wales. Orton has recently found evidence that the wilt of cotton and of cowpeas can probably be prevented by the selection of resistant individuals. Pierce and others have shown that curled leaf of the peach can be prevented by fungicidal sprays. The saving from curl in one year on one variety in one peach orchard in California was $12,700 and the estimated saving to the whole state was $400,000. Waite blazed the way for a whole series of observations on self-sterility of orchard fruits by demonstrating that a supposed pear disease infesting a great orchard in Virginia was nothing else than sterility of the flowers to their own pollen, and could be overcome by planting in the orchard an occasional pear tree of a different variety blooming at the same time or by grafting in such variety. Galloway and Dorsett have shown that the leaf spot of violets may be overcome by the selection of resistant individuals. Jones has been remarkably successsful in protecting potatoes from leaf blight by use of copper fungicides. Nearly every experiment station man has been able to chronicle some interesting treatment or important discovery.

If we consider the sentiment of the community at large respecting this kind of scientific work, the change has been equally great. From being merely 'bug hunters' and 'queer fellows,' the entomologist and mycologist have become people of importance. Farmers, fruit growers, gardeners and hothouse men are no longer skeptical or indifferent, but are eager to get the last word and quick to apply each new discovery. A recognition of the importance of plant pathology is also gradually extending to State legislatures and national bodies of legislation, and the time is not far off when appropriations for the study of plant diseases will be as prompt and liberal, in this country at least, as they are now for any line of work which is fully recognized by the men who legislate as important for the general welfare of the country and beyond the possibilities of private inquiry. Diseases which annually deplete the large civilized countries of hundreds of thousands of dollars, *e. g.*, cotton blights, grain rusts, potato rots, and which not infrequently assume an epidemic form and sweep out entire industries, *e. g.*, coffee disease of Ceylon, sugar-cane disease of Java, peach yellows of the United States, Anaheim vine disease, are certainly legitimate objects of governmental inquiry. I need not argue this point.

Some words, finally, as to the future. The prophet is always at the mercy of events. Nevertheless I shall venture a few predictions. First of all, we may predict for plant pathology in the United States during the next fifty years a wonderful development, since it appeals very strongly to the genius of our people. This being taken for granted, how shall that development be best facilitated? The facts which lie on the surface of things, as regards both the causes of disease and the treatment of the same, have now been pretty well picked up. In my judgment, the treatment of diseases by spraying with copper fungicides has reached its climax and is now on the wane. We shall have to devise other methods for dealing with many plant diseases. Plant breeding is one of the most hopeful. It is a slow process, and the man in the field will sometimes become impatient unless he is a philosopher as well as a farmer. Field hygiene is also a matter of prime importance. Suitable rotation of crops must be practiced, and as far as possible diseased material, and the carriers of such material, must be destroyed. I lay much stress upon the last statement. Insects in particular are responsible for much more than the direct damage they cause.

The men who enter this field from now on must have a better training and a more versatile one than those who have cultivated it in time past, and the emphasis should be placed on laboratory work and laboratory training. It goes without saying that the man who would become a useful pathologist must have considerable familiarity with the literature of his subject. In other words, he must know how to use literature, and must be a linguist, or able to command linguists. He ought also to have a very considerable amount of technical training in physics and chemistry and should know something of zoology. In the way of preliminary training, eight years of university work, or its equivalent, is not too much, and a very considerable part of at least four years of this time the student should spend on organic chemistry. He must not expect to accomplish very much as a pathologist unless he has also become familiar with a very considerable body of knowledge respecting the behavior of plants under normal conditions. In other words, to be a good pathologist he must be a good physiologist, and to be a good physiologist he must first be a good chemist and physicist, for at bottom physiology rests on chemistry and physics, and the advances in this line during the next fifty years will undoubtedly be made by men who approach the problems of biology from the standpoint of physiological chemistry. Given all this, and still the man will not be eminently successful unless he is a born experimenter; I mean by this one capable of reasoning closely, and of devising ingenious methods of extorting from nature her well hidden secrets. This is, of course, asking a good deal of one man, and is more, perhaps, than can be expected of most men. Very likely a solution of the question will be found in many cases by a union of forces. No man is likely to solve these problems who approaches them from the purely chemical standpoint. Something more is required. The pathologist should be the guiding mind, but he must associate with himself a competent physiologist and one or more skilled chemists having some flexibility of mind and a decided inclination to study living things rather than dead things. The old routine ash analyses of the chemist are of no help to us. We wish to know the proximate rather than the ultimate elements of the plants we are studying, and to know how these vary in quantity and kind under changed conditions. In other words, what we wish to know is not how much carbon, hydrogen, oxygen, nitrogen, potash, phosphoric acid, etc., the plant contains, as determined by ash analyses, but in what form it exists in the living plant. We wish to know the kind and quantity of each of the organic acids, and how they vary in amount from time to time under changing conditions. We wish to know all about the sugars, the fats, the tannins, the proteids, the amids, the glucosides, the enzymes, etc., changes in all of which play an important part in nutrition and in predisposition to disease. How are these substances increased, diminished or changed by changing external conditions, either natural or of man's devising, *e. g.*, by foods added to the soil, by fungicides sprayed upon the foliage, by heat, or cold, sunshine or cloudy weather, drought or excessive precipitation? We desire to study the chemical-physiological requirements of the parasites in the same minute way. Then we shall be able to put the two kinds of evidence together and begin reasoning.

Two or three congenial men, having each his special training in the lines indicated, would be able to accomplish much more in solving the difficult problems which confront us than any single man. But I cannot divorce myself from the thought that the pathologist should himself be a chemist and a physiologist. There must certainly be a deeper study of the intimate nature of the plant in health and disease if we are to determine just what constitutes immunity in many given cases and just what is the best method of checking the prevalence of many of our most vexatious diseases. I may refer, for example, to the difficulties which lie in the way of understanding the action of even so well studied and simple a thing as Bordeaux mixture. In recent years we have heard a good deal about injuries due to the Bordeaux mixture, especially on the peach and plum. Why are these trees more susceptible than the apple and the pear or the grape? Why does Bordeaux mixture appear to be more injurious one season than another season, or in the hands of one man than in the hands of another man? Only an intimate knowledge of the nature of this substance and of the chemical physiology of the plants themselves can furnish an answer to these questions.* I may refer also to a whole group of diseases, the etiology of which mere field study and the ordinary laboratory methods do not appear to be competent to unravel; for example, the California (Anaheim) vine disease, the wilt of the orange, the sereh disease of the sugar cane, gum diseases, the yellows and rosette of the peach, the winter blight of the tomato, the internal brown spotting of potato tubers, etc. We may confidently expect that these obscure diseases will yield up their full etiology to careful study at some time in the future, but it will have to be a more thorough and exhaustive study than any that has yet been given to it and by men better trained for the solution of the special problems involved. A good beginning on this class of diseases has been made by Beyerinck and Woods in the study of the Mosaic disease of tobacco.

* Since this was written considerable light has been thrown on the subject by Mr. J. F. Clark (*Bot. Gaz.*, January, 1902, p. 26).

In the time which has passed, much attention has been given to the parasite and comparatively little to the host plant. The plant has seemed to many in the nature of a passive agent. This is far from being the true state of the case. In time to come I would not have the parasite studied less (it must be inquired of with still greater care, especially as to what are its limits in the use of foods, and in the toleration of non-foods), but I think that the host must also, certainly, be studied more diligently if the wonderful progress in plant pathology during the last two decades is to continue. To my mind, the problem of problems in pathology, both animal and vegetable, during the next fifty years will be the varying nature of the host plant or host animal as related to the parasite. This is the burning question. Why is it that some individuals are so very susceptible to disease and others so resistant? Why is it that the same organism is more susceptible at one age, or at one time or season, than at another? These are questions intimately connected with structure and with changes in secretion and excretion, *i. e.*, with the complex chemistry and physics of the individual body, and we shall never be able to solve the difficult problems of plant immunity and put our knowledge into practice for the prevention of diseases until we have a much more intimate acqaintance with the plant cell as a chemical laboratory, or as a physio-chemical laboratory, if you prefer that term. When we are able to point out clearly just what the chemical and physical changes have been which lead up to susceptibility to a given disease, then we shall have gone a very long way toward pointing out to the practical man the methods by which he will be able to avoid bringing about those specific changes which end in disease. It is certainly entirely within the bounds of the possible to know definitely just what particular changes lead to disease, *i. e.*, tend to invite a given parasite, or a given degeneration, and, knowing these, to put the plant or animal under such conditions as to food, light, air, etc., as will lead to the development of counter changes tending to ward off disease. A beginning has already been made, but much remains to be done, and a more inviting field of research does not anywhere lie open to the young and earnest experimenter.

The so-called ' practical man ' has gone about as far as he can go and must have help from the technical and laboratory man. Personally, the speaker has no sympathy with that line of thinking that would hold the pathologist to the narrowest kind of experimental or field work, or which requires him to make bricks without straw. Of course, I mean bulletins without new discoveries to put in them. Nothing is gained by repeated threshing of old straw, and time, the most precious of all things, is lost. Haphazard experimenting is not science. Every decade will not be fortunate enough to stumble on a Bordeaux mixture. The trained pathologist should be given plenty of time and the largest liberty, and allowed to work out his own salvation as best he can. This he must do very largely by experimental devices, and he certainly will never be able to get very far without a thorough technical training and use of the exact methods of the laboratory, or, as I have already pointed out, without chemical knowledge and much assistance from the chemist and physicist. I would not disparage field work. It is right as far as it goes, and I think every pathologist ought to have a thorough acquaintance with diseases as they occur in the field; but a man may work all his life in the field and never get beyond a rule of thumb, if he does not also have that technical training which is usually acquired only in the laboratory. The pathologist must be able to see all that the practical man sees, and a great deal more. In other words he must not only see that things go on in a certain way in the field, but he must also be able to probe beneath the surface and determine why. It is then, often, not difficult for him to make nature conform to some other and better plan whereby harvests are saved and the hungry are fed.

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*THE BIOLOGICAL BASIS OF LEGISLATION GOVERNING THE LOBSTER INDUSTRY.**

CAUSES OF THE DECLINE.

THE causes of the growing scarcity and the yearly diminishing average size of the lobsters caught are: (1) *The natural demand,* arising from an increasing population. This increased demand has not been met by a correspondingly increased source of supply. (2) *The existing laws,* for the reason that the destruction of adults has been permitted. The present laws, with their practical difficulties of enforcement, have had an adequate trial. The decline of the lobster industry demonstrates that these laws have proved inefficient for increasing or even for maintaining the supply. The chief defect of the present laws seems to lie in permitting the destruction of adults.

SUGGESTIONS FOR REMEDIAL LEGISLATION.

Of the suggestions for legislation to check this decline, seven, either singly or in

* Abstract of a 'Report' to the Massachusetts Commissioners of Fisheries and Game, and published in their 'Annual Report' for 1901 (Public Document No. 25).

combination, appear to be especially prominent:—

1. A close season (*a*) for a portion of each year, or (*b*) for a term of years.

2. The continuance of the present 10½-inch law, under more effective enforcement.

3. The substitution of a 9-inch law.

4. The prohibition of the killing of egg-bearing lobsters.

5. The prohibition of the killing of any female lobsters.

6. The removal of all restrictions as to catching.

And finally, as an entirely new proposition, which I personally venture to advance,

7. The protection of all adult lobsters above the breeding age, and the removal of restrictions on the catching of the immature which are of satisfactory marketable size.

A just and adequate law which meets most requirements, wherever identical conditions obtain, will increase the chances of securing effective uniform legislation throughout the lobster-producing districts.

An impartial balancing of the merits and defects of the several propositions is here attempted:

1. *A Close Season.*—(*a*) For a portion of the year. A close season may bring manifest and satisfactory results in cases where the animal is a rapid breeder, or where the young reach maturity in a short time. But a close season is not equally applicable for checking the numerical decline of every, or any particular, animal. This is notably true of the lobster. A close season must fail to bring the expected results, for the reason that the lobster is a slow breeder, laying eggs but once in two years, and carrying these eggs, attached to the modified legs under the abdomen, for ten or eleven months after laying; while the young require probably from four to seven years to reach maturity and attain a length of seven to ten inches.

Finally, the fundamental defect of a close-season law is that it restricts the demand but does not adequately and economically increase the supply.

Aside from the practical difficulties of securing a uniform close season throughout the lobster range, and enforcing the laws, the value of the close season to the lobster as a race is commensurate with the duration of this close season. The longer it extends, the better for the lobster but the worse for man. The burden upon investments in the lobster fisheries is increased. The absence of the lobster from the human food supply is felt by the public. Yet all this is of little avail, for the effects of the close season are not permanent. The causes of the decline have not been removed. The lobsters, through a close season, either from one to six months each year, may have a chance to 'catch up,' only to be themselves 'caught up' with redoubled energy, resulting in a glutted market, and consequent economic waste for a time, with the certainty of a rapid return to the former conditions which made a close season necessary.

(*b*) Close season for a term of years. Most of the foregoing statements apply also to a close season for a term of years. The primary inherent defects in the close season are that it does not reach the cause of the decline, and it fails to recognize the fact that the lobster can and should be reckoned as a perennial and perpetual food for man. Human effort can so control conditions that the supply may be large or small. By taking proper measures the lobster supply can be made abundant and continuous, instead of intermittent.

2 and 3. *Continuance of Present Length Law or Substitution of Another.*—The 9-

and 10½-inch laws are the ones which have met widest favor. They are identical in inconvenience of application and in difficulty of enforcement.

Neither the 9-inch law in New York, the 9-inch and 'female lobster with spawn attached' in Connecticut, 9-inch and a closed season in Rhode Island, 10½-inch in Massachusetts, 10½-inch and 'female lobsters while carrying their spawn or hatching their young' in New Hampshire, 10½-inch since 1897 in Maine, nor the 10½-inch and a closed season from June 30 to January 14 in the Maritime Provinces, has prevented the continued rapid decline in (1) the number of lobsters caught, (2) the average size of the lobsters caught, (3) the average number of egg-bearing females reported, (4) the number of persons who can depend upon the fisheries for support, or (5) has checked the rapid rise in the price of lobster meat.

Further, these laws have been found by experience to be difficult of application and expensive in enforcement and alike disagreeable to officer and offender.

The sole apparent merit of this law seems to be that it does prevent the catching of some lobsters; just how many is dependent upon the honor of the fishermen and the means of enforcing the law. Its greatest defect, and from a scientific point of view an irreparable one, consists in the fact that it affords no protection to those lobsters which most need protection—the mature breeding individuals—but puts a premium on their capture through tacitly specifying that only adults above the breeding age shall be killed. What would be the effect upon our supply of poultry and eggs if a law should be made 'protecting' poultry under one year, or under a certain size or weight? It absolutely ignores the biological laws which man has found by experience to be of the utmost importance wherever it has become necessary to increase the natural food-supply to meet the increasing population—the protection of the adult animal in order to secure a supply of young of that species.

4. *The Prohibition of the Killing of Egg-bearing Lobsters.*—To prohibit the killing of any egg-bearing lobsters is good legislation so far as it goes, but it is open to the objection that it pushes into prominence the temptation to comb off the eggs, and thus make the lobster a marketable one. It has practical difficulties of enforcement.

5. *The Prohibition of the Killing of any Female Lobsters.*—The prohibition of the killing of any female lobster would promise more effectiveness were it not for the fact that it involves catching, and a subsequent sorting and liberation.

6. *The Removal of all Restrictions as to Catching.*—The proposal to remove all restrictions as to catching lobsters must inevitably lead to the destruction of the industry, unless a sufficient artificial supply can be maintained to meet the demand, and thus far this seems impracticable. Certainly satisfactory results have not been reached in the case of the lobster, though further investigation and examination must yield far-reaching results.

7. *The Protection of All Adult Lobsters Above the Breeding Age, etc.*—The method of protecting all the adults, and catching only a portion of the young, promises very satisfactory results in the case of the lobster, for the reasons:

1. That the ratio of the biological, *i. e.*, reproductive, value increases very rapidly after the size of nine to ten inches has been reached, as shown by Professor Herrick's table.

2. The number of enemies diminishes very rapidly as the lobster increases in size.

SUGGESTIONS FOR NEW LEGISLATION.

The logical basis, then, for the law is:

1. Protect the adults. Catch only the small lobsters, not the large ones.

2. Protect enough of the young to ensure a sufficient number of adults.

3. Protect those below a size which experience has shown to be adapted for economic use, say six inches.

4. Use only a legal standard pot, having the opening of such size as to prevent the entrance of a lobster say above nine or ten inches, and with slats far enough apart and numerous enough to insure the escape of all lobsters less than six inches. Fix a date when all pots shall conform to the standard.

5. Penalize the possession or sale of lobsters above ten inches and below six inches, and of pots not conforming to the legal standard.

6. Establish a State committee, to coöperate with similar committees from the other lobster-producing States and the British maritime provinces, for considering the advantages and possibilities of uniform lobster laws, for coordinated investigations of the important economic facts in the natural history of the lobster, and for devising improved methods of artificial lobster culture. Rhode Island is obtaining very valuable and practical results on some important phases of the question under the direction of Professor Mead.

The chief apparent objections are:

1. That such a proposal as has been outlined is too radical, too great a departure from precedents and from the laws in force in other States. To this it may be answered that the existing lobster laws have little common-sense foundation; they have been based upon misconceptions, and often, no doubt, upon ignorance and local politics; they are directly contrary to scientific experience, and the continued decline of the lobster industry has proved them to be ineffective for the purposes for which they were instituted. They are based neither upon the laws of human economy nor upon the natural history of the lobster.

2. It has been claimed that 'such laws as those proposed would lead to the capture of all the lobsters.' At first an actually greater number of lobsters would undoubtedly come into the market; but the increased number of individuals killed would not result in such an increased weight as to materially affect market conditions, and the productive capacity of the protected individuals would be expected to more than offset the apparent loss from the marketing of immature individuals. In other words, the actual value of one above ten inches long in potential productive capacity is many times that of one between six and ten inches long, and man could use as food a larger number of six-inch lobsters without doing the biological damage which results from the killing of a single lobster of from nine to eleven inches long, and at the same time have an actually greater weight of lobster meat. If it is feared that under this proposal the lobster does not get sufficient protection, make the limit still narrower, say from between eight or nine inches to six inches.

1. Such a law would be relatively easy of enforcement, through the inspection of lobster pots.

2. It would work a minimum injury to vested interests, since sufficient time can be given to make all pots conform to the standard.

3. It does not remove the lobster from the market, and so does not interfere with the immediate or future interests of fishermen, dealers and consumers.

4. By protecting those lobsters which are of greatest biological value the interference

with the natural laws of increase is minimized.

5. It furnishes a basis for uniform legislation throughout the lobster-producing section. Being based upon common sense, and in close conformity with the natural history of the lobster and with human scientific experience with food supplies, it commends itself to fishermen and others who know human nature and the lobster in a practical way.

Finally, the proposed law, while fundamentally scientific, is eventually a compromise measure and combines the advantages (1) of a close season throughout the year for a part of the lobsters (*i. e.*, for those productive adults above a size to be agreed upon), and (2) of the size limit, thus meeting the wishes of the believers in both the $10\frac{1}{2}$- and 9-inch laws. It seems to promise effectiveness in meeting existing conditions and in checking the decline. It is adapted for ready enforcement without resort to methods distasteful to officers and people, and at a minimum expense to the state.

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MEMBERSHIP OF THE AMERICAN ASSOCIATION.

The following have completed their membership in the American Association for the Advancement of Science since December 1, 1901.

Maurice Albaugh, Manufacturer, Covington, Ohio.

Emil Poole Albrecht, Secretary of The Bourse, Philadelphia, Pa.

G. W. Allyn, Secretary of Academy of Science and Art, Pittsburg, Pa.

Thomas R. Almond, Mechanical Engineer, Brooklyn, N. Y.

Frederick James Amweg, Honolulu, Hawaiian Territory.

James Thomas Anderson, Lieutenant, U. S. Army, Colorado Springs, Colo.

Rafael M. de Arozarena, Consulting Engineer, City of Mexico.

George Hall Ashley, Professor of Biology and Geology, College of Charleston, Charleston, S. C.

Stephen E. Babcock, Civil and Hydraulic Engineer, Little Falls, N. Y.

Hugh P. Baker, Bureau of Forestry, Washington, D. C.

Edwin Swift Balch, Lawyer, 1412 Spruce Street, Philadelphia, Pa.

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Lemuel Call Barnes, D.D., 310 Oakland Avenue, Pittsburg, Pa.

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SCIENTIFIC BOOKS.

Regeneration. By Thomas Hunt Morgan, Ph.D., Professor of Biology in Bryn Mawr College. Columbia University Biological Series, Vol. VII. New York, The Macmillan Company. 1901. Pp. xii+316; 67 text figures. Price, $3.

The high character of the Columbia University Biological Series is more than maintained by its latest publication—Professor Morgan's book on 'Regeneration.' It is rare indeed to find a book which contains so large an amount of research work and which is at the same time of such general interest and importance. This is no mere description of the peculiar and bizarre 'dime museum experiments' of experimental zoology, but rather a thorough treatise on some of the most important methods and results of the new morphology.

To those who can read the signs of the times it is most evident that zoology has been passing through a period of revolution during the past ten years. A strong reaction has set in against the extremely speculative theories as to the factors of evolution, the inheritance or non-inheritance of acquired characters, and the whole 'phylogeny business' of a dozen years ago. The present attitude of most zoologists is more critical, less argumentative and in all respects more wholesome than prevailed when sky-scraping theories were erected on a single square foot of fact. In this wholesome reaction experimental morphology has played a most important part; in fact, it was the attempt to make biology an experimental science which first aroused interest in this subject, and while at times some of these experimental morphologists have illustrated the uncritical methods which they have denounced, while their conclusions have often been open to the criticism of having been hasty and ephemeral, no one can deny the fact that their work has introduced a new spirit into the study of zoology.

In this work the author has been one of the most productive and at the same time one of the most careful investigators. He saw, as apparently few others did, that the development of fragments of eggs and embryos was at bottom the same problem as the regeneration of parts of adult organisms, and during the past ten years he and his pupils have done a surprising amount of work on the regeneration of embryos and adults. There is probably no other living man so well fitted to treat this subject. To almost every topic discussed in the book, save the ones on regeneration in plants and on hypertrophy and atrophy, the author has made important original contributions. The literature list at the end of the book, which is very complete, covering the most important papers on regeneration from the time of Aristotle to the present day, includes 470 titles, and one tenth of this total list has been contributed by Morgan and his pupils. As a result the discussion of each topic evinces a thoroughness of treatment and a ripeness of judgment which could come only from long and intimate acquaintance with the problems involved. The book is therefore not merely a summary of the work which has been done on regeneration, but it is also a splendid contribution to knowledge.

In the fourteen chapters of the book the following subjects are presented: An historical and general introduction, the external and internal factors of regeneration in animals, regeneration in plants, a discussion of the supposed relation between regeneration and liability to injury, regeneration of internal organs, physiological regeneration, fission, budding and autotomy, grafting, origin of new cells and tissues, regeneration in egg and embryo, theories of development and of regeneration, general considerations on organization, vitalism and teleology. Of these topics the ones on regeneration and liability to injury, regeneration in egg and embryo, theories of regeneration and of development and the general considerations are of most general interest.

The greater part of the chapter on regeneration and liability to injury has already appeared in SCIENCE, and it need only be said here that Morgan has established in the most convincing manner the fact that there is no causal relation between the two, and that therefore it is impossible to regard the wonderful adaptations of regeneration as a result of the action of natural selection. It has long been recognized that natural selection is not so much a theory of evolution as an attempt to explain on causal grounds the remarkable and exquisite adaptations shown by living things. Nowhere are such adaptations more striking than in regeneration, and yet here it is in some cases quite certain that such adaptations cannot be attributed to the action of the Darwinian or of the Lamarckian principle. All theories which attempt to explain adaptations hold that they are due to experience; Lamarckism, that they are the direct result of use, disuse and need; Darwinism, that they are the indirect result of experience through the survival of the fittest. No theory yet advanced can explain adaptations to conditions never experienced before, and yet in the regeneration of animals there are adaptations which are undoubtedly of this sort. The credit of first having shown the inability of natural selection to explain certain cases of regenerative adaptation belongs to Gustav Wolff rather than to Morgan, but the latter has greatly enlarged and extended the evidence in favor of this position. Nevertheless the author is conservative in his treatment of this question; he launches into no 'railing accusations' against natural selection, but is content to point out its insufficiency in the cases under discussion, wisely leaving others to draw their own conclusions as to its general applicability.

Likewise in his treatment of the theories of development and regeneration the author shows a wise conservatism which is in refreshing contrast to some of the revolutionary assertions of the earlier stages of *Entwicklungsmechanik*. The author's conclusion that regeneration and development belong to the same general group of phenomena and that the same problems are met with in the two is a most important and valuable one. His present position that the development of egg fragments is only a special case of regeneration plus the phenomena of development is fundamentally like the view expressed earlier by Roux ('93) and unlike the position which Driesch and Morgan formerly maintained. Thus he says (p. 247): "We have, however, no reason to suppose that all the (cleavage) cells are alike because they are all potentially equal. Even pieces of an adult animal—of hydra or of stentor, for example—can produce new whole organisms, although we must suppose these pieces to be at first as unlike as are the parts of the body from which they arise. Moreover we do not know of a single egg or embryo in which we cannot readily detect differences in different parts of the protoplasm." Contrast this with Driesch's famous dictum, 'By segmentation perfectly homogeneous parts are formed capable of any fate,' or with Morgan's former statement that 'the micromeres (of the sea-urchin egg) are undifferentiated blastomeres, and are not set aside to form any special organ, because normal embryos still come from such fragments without micromeres.'

The author finds the great problems of development and regeneration centering in the determination of the causes of differentiation and these causes he finds in the organization. What this organization is, however, cannot be explained any more than the physicist can explain what gravity is. The author does not conceive this organization to be the outcome of the integration of biophores or other 'vital units,' nor can it be identified with cells. "Just as the properties of sugar are peculiar to the molecule and cannot be accounted for as the sum total of the properties of the atoms of carbon, hydrogen and oxygen of which the molecule is made up, so the properties of the organism are connected with its whole organization and are not simply those of its individual cells or lower units." The smallest pieces of organisms capable of regeneration are enormously larger than individual cells, and therefore 'the organization is a comparatively large structure.' It seems to me that in this matter the author loses sight of the fact that organization like individuality is a thing of degrees and stages. There is undoubtedly such a thing as the cell organization and this is capable of performing certain functions; whether or not it is able to perform the function of regeneration depends upon the animal in question. In protozoa and the egg cells of metazoa it is capable of regeneration as well as of all other functions; in adult metazoa regeneration can be accomplished only by pieces larger than cells, *i. e.*, by an organization of a higher order than that of the cell.

In connection with the question of organization the author makes the pregnant suggestion that it may consist in a system of tensions in the living substance rather than in the polarity or other properties of ultimate units. Such a view would accord well with the facts of regeneration and while 'we cannot picture to ourselves in a mechanical way just how such a system could bring about the suppression of growth in one region and allow the maximum amount in another region,' it not only accords well with the facts but brings a large number of phenomena under a common point of view.

However attractive neo-vitalism may be for others, it has no peculiar charms for the author who refuses to be stampeded by the apparently intelligent and purposive adaptations of organisms to conditions never experienced before or by the 'proportionate formation of parts' in regenerating embryos and adults. Such phenomena, he thinks, "may be entirely beyond the scope of legitimate explanation, just as are many physical and chemical phenomena themselves, even those of the simplest sort. * * * Even in the physical sciences it would not be difficult to establish a vitalistic principle, or whatever else it might be called, if we choose to take into account such properties as the affinities of atoms and molecules, etc. * * * For my part I see no grounds for accepting a vitalistic principle that is not a physico-causal one, but perhaps a different one from any known at present to chemistry and physics."

Finally, if the adaptations shown in regeneration cannot be explained by natural selection are they to be explained by some teleological principle? To this question the author attempts no direct answer. It is pointed out that not all forms of regeneration are adaptive, *i. e.*, useful, and that 'unless we suppose that some external agent, acting as we do ourselves, directs the formative processes in animals and plants, we are not justified in extending our experience as directive agents to the construction of the organic world.'

These brief extracts do not do justice to the author's argument, but they serve to show his general position on these important questions. The book will undoubtedly take a prominent place among the standard biological works of the world.

E. G. C.

Die Farngattung Niphobolus. By Professor GIESENHAGEN. Jena, Gustav Fischer. 1901. 8vo. Pp. xii + 223. Price, Mk. 5.50.

For a clean piece of monographic work the ideal conditions are a genus of plants of moderate size whose distribution is somewhat circumscribed, and with sufficient adaptability to environment to have induced striking structural characters among the species. Such a condition is represented in the present genus. To monograph such a genus one needs, in addition to library and herbarium facilities, to be possessed of a good knowledge of technique and above all to know the plants in the field. Such a knowledge of this genus Professor Giesenhagen gained in his travels in Sumatra and other portions of the East Indies and the result is a clearly written monograph of the fifty species of the genus.

The genus forms a rather natural group of ferns which has commonly been included under the genus *Polypodium*, and is easily recognized by the vestiture of star-like hairs covering the laminæ. The center of distribution appears to be in India and South China where nearly one half the species (21) are found. Westward the genus extends to Africa (two species), northward to Japan (three species), eastward to Taiti (one species), and southward to Australia (two species). Endemic species are known from most of the larger islands of this region, as Bourbon (one), Ceylon (three), Sumatra (one), Philippines (three), Java (two), Celebes (two) and Borneo (one). One or two species are well known in cultivation under the name *Polypodium Lingua*.

Sixty-five pages of the monograph are devoted to the morphology of the genus and the details of stem and leaf anatomy are clearly brought out, as are the modifications resulting from habitat and environment. This portion of the work is illustrated by a well-selected series of text figures illustrating structures comparatively, which is the only satisfactory method for a work of this sort. The descriptive portions are very clearly and fully made, an entire paragraph being given to anatomical details under each species—a valuable and noteworthy addition to ordinary taxonomic description. The English methods in taxonomy are frequently commented upon with no uncertain sound, being characterized as a classification with 'hands and eies only' (*sic*) by which they group together widely different species. The work of the English systematists who have hitherto recognized only twenty-three species in this group, is sharply contrasted with the careful work of Mettenius and Kunze in Germany. The author, however, forgets to note one feature of German taxonomic methods altogether too common in recent monographic work in his own country, and one that more than once has led him into minor errors that could easily have been avoided. In preparing his monograph, Giesenhagen had access to a loan for a short time of the herbarium materials from Berlin, which is unquestionably the finest Continental collection, and also had access to the types of Blume's Javan ferns from the Museum at Leyden, but the richest collection of all in this and every other genus of ferns, namely, that at Kew, England, the author never consulted. In fact, German monographers rarely consult this magnificent collection, and as a consequence of this neglect, go on producing monographs which contain either avoidable errors or lamentable omissions. To cite an instance from the present case, the English botanists had confused a common Indian fern with one of Blume's Javan species, of course without having seen Blume's plant, for English botanists do not always take the trouble to gather evidence if it involves crossing the English Channel to get it. Our present author, after an examination of Blume's type finds the Indian plant something very different, as might have been expected, and in spite of the fact that the Indian plant already had been named independently by other English botanists commencing with Wallich, proceeds at once to name it '*Niphobolus Mannii* n. sp.' This is surely an economical method of procedure—in fact saves the time and money necessary to visit Kew—but as a question of ethics or scientific accuracy it is not to be commended in a formal monograph. Wallich's name must hold for this plant unless there should prove to be an earlier one.

In short the principal criticisms that can be offered to the work in hand are those that bear on the lack of accuracy in citation and nomenclature and yet these imperfections mar an otherwise admirable volume. In citing specimens examined the author often uses an entire page and sometimes two pages in needlessly quoting the entire label from the herbarium sheet—data important in their proper place, but in even the more extended series here given capable of being condensed and better classified into ten lines in so far as they give information respecting geographic distribution. On the other hand *icones* are rarely cited and in some cases the reader is in doubt both as to the original author of the species described and its type locality. Last of all the name *Niphobolus* is itself untenable. The author, working under the old conception that a genus is a description or a definition instead of a group of related species, passes over Desvaux's genus *Cyclophorus* (1811) because neither in his generic description nor in those of its six species which the present author admits 'alle echte *Niphoboli* sint' does Desvaux mention the peculiar vestiture which characterizes the members as now understood. Because of this and because Kaulfuss in 1824 had substituted *Niphobolus* for *Cyclophorus*, since the latter name had been used for a genus of shells, our present author unfortunately uses the latter name, which in the rational and progressive system now in use in biological nomenclature cannot stand. It is unfortunate that so complete a monograph should be lacking in the minor essentials of modern scientific accuracy.

Lucien M. Underwood.

The Practical Methods of Organic Chemistry. By Ludwig Gattermann, Ph.D., Professor in the University of Freiburg. With numerous illustrations. Translated by William B. Schober, Ph.D., Instructor in Organic Chemistry in Lehigh University. Authorized translation. The second American from the fourth German edition. New York, The Macmillan Company. 1901. Pp. 359.

Gattermann's book is favorably known in organic laboratories. It consists of a brief general part dealing with analytical operations and laboratory methods, and a special part of organic preparations. To quote, 'To each preparation are added general observations which relate to the character and general significance of the reaction carried out in practice.' This feature is a very great help to the student.

This edition includes a number of new preparations. It has been well translated by Dr. Schober, and is clearly illustrated.

E. RENOUF.

Laboratory Exercises in General Chemistry. Compiled from various sources by G. W. SHAW, A.M., formerly Professor of Chemistry at Oregon State Agricultural College. For use in connection with Storer and Lindsay's 'Manual of Chemistry.' New York, American Book Company. Pp. 63.

This book is better than most of its class. A generally valid objection to the use of laboratory books instead of the text-book is that they enable a student to perform an experiment without thought of the principle which it illustrates. Such objection cannot be made to this book, for each exercise contains many questions requiring verbal answer to the instructor or written answer in the laboratory note-book.

E. RENOUF.

The Elements of Qualitative Analysis. By WM. A. NOYES, Ph.D., Professor of Chemistry in the Rose Polytechnic Institute. Fifth edition, revised. New York, Henry Holt & Company. 1901. Pp. 101.

In this new edition of his excellent and well-known manual, Professor Noyes introduces and expands the method of Abegg and Herz for the systematic detection of acids. He divides the acids into eight groups, using as reagent for group 1 concentrated sulphuric acid; for groups 2, 3 and 4 calcium chloride, barium chloride and zinc chloride respectively in neutral solution; for group 5, color reaction with ferric chloride; group 6, silver nitrate; group 7 contains the acids whose calcium, barium, zinc and silver salts are soluble; and group 8, the commoner organic acids which carbonize on heating. This method seems simple and little open to error.

E. RENOUF.

SOCIETIES AND ACADEMIES.

THE CHICAGO SECTION OF THE AMERICAN MATHEMATICAL SOCIETY.

THE eleventh regular semi-annual meeting of the Section was held at the University of Chicago, on Saturday, March 29, the first session opening at 10 o'clock A.M. At the morning session Professor Townsend, of the University of Illinois, and at the afternoon session Professor Moore, President of the Society, occupied the chair. The following papers were read:

Morning Session.

Nachtrag zum Artikel: 'Zur Erklärung der Bogenlänge,' u. s. w.: Professor O. STOLTZ, Innsbruck, Austria.

'The Mutual Independence of Hilbert's Axioms within the Various Groups': Mr. ARTHUR T. BELL, University of Illinois.

'On the Superosculation of Surfaces': Professor H. MASCHKE, University of Chicago.

'A Certain Conic connected with the Isotomic Relation': Professor LAENAS G. WELD, University of Iowa.

'Concerning the Second Variation in the Isoperimetric Problem': Professor O. BOLZA, University of Chicago.

'Concerning the Isoperimetric Problem on a Given Surface': Professor BOLZA.

Afternoon Session.

'Some Remarkable Cases of Libration among the Small Planets of the Hilda Type': Professor KURT LAVES, University of Chicago.

'On the Interchange of the Order of Differentiation': Professor E. J. TOWNSEND, University of Illinois.

'On the Group Defined for Any Given Field by the Multiplication Table of Any Given Finite Group': Professor L. E. DICKSON, University of Chicago.

'Theorems on the Residues of Multinomial Coefficients with respect to a Prime Modulus': Professor DICKSON.

The committee appointed at the last meeting of the Section to consider and report a scheme of equivalent requirements for the Master's degree, for candidates making mathematics their major subject, presented a preliminary report which was discussed and ordered to be manifolded for distribution among the members of the Society. The report is in the hands of the secretary of the Section and a copy will be sent to any members applying for it.

THOMAS F. HOLGATE,
Secretary for the Section.

NEW YORK ACADEMY OF SCIENCES.
SECTION OF BIOLOGY.

At a regular meeting of the Section on March 10, the following program was offered:

'The Four Phyla of Titanotheres': Henry F. Osborn.

'The Early Development of Sharks from a Comparative Standpoint': Bashford Dean.

'The Cytological Phenomena of Maturation and First Cleavage in the Cirriped Egg': Maurice A. Bigelow.

'The Effect of the Wind on Bird Migration': C. C. Trowbridge.

Professor Osborn presented some results recently obtained for a U. S. Geological Survey Monograph. The Lower Oligocene Titanotheres prove to belong to four distinct phyla, to which the prior generic names *Titanotherium, Symborodon, Megacerops* and *Brontotherium* may be applied. The chief distinctions are found to be in the dolichocephalic or brachycephalic form of the skull, in the shape, length, position and mechanical relations of the horns, and in the number and form of the incisor and canine teeth. Each genus obviously had distinctive modes of fighting, locomotion and feeding. *Titanotherium* extends from the base to the summit of the Lower Oligocene. It is distinguished by its long narrow skull, short horns, powerful canines, vestigial incisors. *Megacerops,* on the contrary, is broad-skulled, short-horned, with obtuse canines, and with at least one upper incisor. *Symborodon* is distinguished by the narrowing of the anterior portion of the premaxillaries, reduction of all the anterior teeth, and by elongate horns placed immediately over the eyes. In *Brontotherium,* the horns are by far the largest and most powerful, and acquire an extreme anterior position, absorbing the free portion of the nasals; all the upper cutting teeth persist; great buccal plates are evolved; and the skull measured along the base line is extremely brachycephalic. The four types were illustrated by models and diagrams.

Professor Bashford Dean considered briefly some points in the development of sharks, and attempted to reduce the type of the early development of the recent types to that of their holoblastic ancestor. This form probably occurred within the strict limits of the group Elasmobranchii—for the absence of clasping organs in the palæozoic genera of Acanthodians and Cladoselachids predicates external fertilization, and eggs many in number and of small size. In the line of this comparison, reference was made to the early development of the Japanese 'pavement-toothed' shark, *Cestracion japonicus,* in which, as the author showed in a recent number of the 'Annotationes Zoologicæ,' surface furrows are present, traversing the yolk, and are best interpretable as reminiscent of holoblastic cleavage. In the peculiar type of early development in *Chimæra,* total cleavage is suppressed until about the time of gastrulation, when cleavage furrows appear in the region of the lower pole and come to divide the egg into a number of distinct blastomeres, only one mass of which, however, become enclosed in the yolk-sac of the embryo. The remaining blastomeres, by a process of continued division, provided nutriment for the embryo *via* gills and gut. Dr. Dean announced the presence in *Chimæra* of a true archenteric invagination, occurring early and at some distance from the margin of the blastoderm. It is small in size, and has a distinct cellular floor. Its (anterior) dorsal wall was compared to the dorsal lip of the archenteron of sharks, as described by Rückert and others. The ventral wall of the archenteron of modern types of sharks has thus lost its cellular character during the process by which the embryo acquired a more perfect and specialized (cænogenetic) mode of obtaining nourishment from the yolk.

The paper by Dr. Bigelow dealt chiefly with protoplasmic movements and associated displacements of the yolk materials in various cirripede eggs during maturation and first cleavage. The telolecithal distribution of the egg substances, the formation and disappearance of a yolk-lobe, and precleavage movements associated with differential distribution of the entoblastic materials were described. Finally, a turning of the first cleavage spindle from a transverse to an oblique axis of the ellipsoidal egg was compared with similar more extensive movements in nematode eggs.

Mr. C. C. Trowbridge presented the results of systematic observations on the effect of the wind on the migration of hawks and many other birds along the Atlantic coast. The principal points of the paper were illustrated by means of diagrams giving the directions taken by the migrating birds under the influence of different winds. It was shown that a knowledge of meteorology was necessary in considering this subject, because the effective winds depend on storm centers traveling eastward. In one case, in the height of the southward migration, a storm center off the coast of Maine caused northerly winds throughout 800,000 square miles in the eastern part of the United States and Canada, the velocity of the wind area averaging twenty miles per hour. A former paper on the subject was briefly reviewed, in which the author showed that flights of hawks and other land birds during the migrations were due to the crowding of the birds in a narrow coast-line path by the wind. The recent observations now warrant the conclusion that hawks and many other birds regularly depend on a favorable wind as a help in their migratory movements, and, as a rule, migrate only when favorable winds occur. A brief account was given also of a retrograde movement of migrating swallows in the spring, evidently due to a return flight of the birds after they had been blown far out of their course by a strong wind from the west.

HENRY E. CRAMPTON,
Secretary.

SECTION OF ANTHROPOLOGY AND PSYCHOLOGY.

A MEETING was held on March 28, Professor Farrand in the chair. The present sectional officers were reelected for the ensuing year.

Dr. Clark Wissler reported on the growth of boys. The annual physical measurements of some three hundred schoolboys were correlated to discover tendencies and directions of growth. It appeared from the data that growth was rather uniform, as for example, when a boy's legs were growing rapidly his arms were also growing at a corresponding rate. By correlating the stature with its increment for the following year it was seen that the sign of correlation changes when the pubertial maximum of growth is crossed. This means that boys who are growing rapidly at twelve, for example, continue to grow rapidly until fourteen or fifteen, when they slow down, while those growing slowly before this period now grow rapidly. Thus it appears that the point of pubertial maximum rate of growth, as determined by mass measurements, is really the point dividing the boys who mature early from those who mature late. The relation is yet more in evidence when the annual increments are correlated without regarding the absolute measurements. The results as a whole seem to show that the rate of growth in any particular year is of no special significance except as an index of the relative maturity of the individuals concerned.

Mr. W. S. Kahnweiler reported on a trip that he made last summer through French Indo-China to the Angkor Wat. His paper was illustrated with lantern views of the trip, and of the architecture and sculpture of the ancient temple. The history of the temple was briefly outlined.

R. S. WOODWORTH,
Secretary.

TORREY BOTANICAL CLUB.

AT the meeting of the Club on March 11, 1902, the first paper, by Edward S. Burgess, was on 'Plant Illustration in the Middle Ages,' being a portion of a contribution to the history of early botany soon to be printed among his 'Aster Studies.' The paper was illustrated by examples from his library, of early woodcuts intended to represent *Aster*, dated 1485, 1499, etc. (long anterior to the first adequate drawing of *Aster*, that of Fuchs in 1542); also examples of the value once put upon the vellum used for manuscripts, showing an Italian manuscript dating perhaps from before 1200, in which torn vellum had been carefully mended before writing. He also exhibited a series of heliotypes representing about twenty-five pages of unpublished mediæval manuscript containing drawings of plants, and nearly as many pages more of decorated text, photographed by Professor

Giacosa, of Turin, to accompany his recent edition of certain of the Salernitan masters ('Magistri Salernitani,' Turin, 1901).

Early plant drawings give their chief attention to outline; particularly of leaves, stem and branches. Flowers were less often and less successfully indicated. The characteristic *habit* of a plant, however, was often caught very perfectly. Figures were copied often with scrupulous care from one manuscript to another. Several causes tended, however, to their degeneration. Pliny charges the blame for the imperfect plant-figures of his time upon lack of skill of copyists. Some of the worst among later errors were those of copyists who had never seen the plant and who were attempting copies of plants of distant regions as in early Anglo-Saxon figures of *Aster* and other classic plants. In other copyists a desire for balance and symmetry overcame their fidelity to the original, so that they conventionalized their plants; as seen strongly in later Italian work exhibited, developed in the fourteenth century from the Salernitan school; and as retained in early printing, Italian woodcuts of 1499 inheriting the same tendency. A fourth source of error in plant-figures was the mediæval love of the marvellous, so that many copyists outdid their text in depicting fictitious monstrosities, as in the fifteenth century pictures of mandrakes, Tartarian lamb, etc.

Some of the earliest plant-figures of which we know were those made by Cratevas, Greek physician to Mithridates, about 100 B.C. Something of their character and form probably still survives to us in certain illustrated manuscripts of Dioscorides, of the fifth century, with figures evidently copied, not from each other, but from an earlier common source. There is great need in the interests of the history of botany, that the project of publishing the figures of the Anician Vienna codex, now laid aside for nearly two centuries, should be revived and carried to successful issue. In the discussion following this paper Dr. Britton, Dr. Underwood, Professor Lloyd and Mr. Eugene Smith participated.

The second paper was by Mr. W. A. Cannon, entitled 'Observations on the Structure of the Ovular Integuments of *Dichelostemma capitatum*.' Colored figures were shown, indicating the final absorption of the inner integument by the developing endosperm. The haustoria of the mistletoe penetrate the oak cortex by secreting a ferment which dissolves the neighboring cell walls; excepting certain lignified cells which become incorporated in the haustoria. So also in this liliaceous plant, better known to many as *Brodiæa,* the haustorial enzyme is unable to dissolve the cuticularized membrane of the integument. Possibly such cases of absorption of non-dissolved cuticularized membrane may be widespread.

Professor Lloyd in discussion suggested that different parts of the ovule may be able to secrete different kinds of enzymes, ready to attack different kinds of tissues simultaneously; at least three different enzymes have been obtained by mechanical means from the yeast-plant. In certain of the Rubiaceæ the formation of enzymes in the megaspore antedates fertilization; and that the pollen-tube develops an enzyme is well known.

The final contribution of the evening was by Dr. N. L. Britton on the 'Morphology of the flower of *Dichondra*,' a plant commonly assigned to the Convolvulaceæ. Its little rotate flowers resemble a saxifrage and are highly incongruous with the Convolvulaceæ.

EDWARD S. BURGESS,
Secretary.

NORTHEASTERN SECTION OF THE AMERICAN CHEMICAL SOCIETY.

The regular monthly meeting of the Section was held on Wednesday, March 26. Professor H. W. Conn, of Wesleyan University, presented an interesting paper on 'Some Aspects of Commercial Bacteriology.' The early history of the use of butter cultures in Denmark was reviewed, and the successful use of the cultures in that country was attributed to the law passed by the government requiring all cream used in making butter to be Pasteurized. This produces a mild butter with the flavor characteristic of the pure culture used. In this country such a mild butter has not met with ready sale, and if the cream has been

Pasteurized, it is possible to produce only a mild butter. In order to procure the more pronounced flavor as desired here, the cream is allowed to ripen and a 'starter' removed for the following day. In this way butter having a characteristic flavor may be produced without the use of a pure culture. Professor Conn believed that the ripening of cream takes place in two stages; the first being the rapid growth of certain albumen-destroying bacteria; and the second, the rapid growth of lactic-acid-producing bacteria. In completely ripened cream the latter only are present and constitute the pure Danish cultures which give mild butter. The former seem to be the cause of the stronger flavor desired in America. They do not affect the flavor of the Danish butter, as they are all destroyed in the process of Pasteurization. It is interesting to note that pure cultures are used in this country to a greater extent by the producers of oleomargarine and 'process' butter than by the dairymen.

The second paper of the evening was read by Mr. S. C. Prescott, of the Massachusetts Institute of Technology, who gave an interesting review of 'The Nature of Enzyme Reactions.'

HENRY FAY,
Secretary.

ONONDAGA ACADEMY OF SCIENCE.

THE 54th regular meeting of the Academy was held in the Historical Rooms, March 21, 1902.

Dr. Charles W. Hargitt spoke on 'Bird Migrations and Food Habits,' emphasizing the remarkable exactness in time with which certain of the birds annually arrive. The time, manner and causes of migrations were fully discussed. In speaking of the 'Food Habits' of birds, Dr. Hargitt pleaded for a fair balancing of the results found in the analyses of the stomach contents, as a single berry *vs.* the harmful insects destroyed, and accentuated the importance of avoiding prejudices.

Professor G. A. Bailey spoke of the 'Traits of Birds,' mentioning the cowbird as a case of degeneration. It was gradually giving up nest-building and becoming more slovenly, as was also true for the American cuckoo. He also spoke of the difference in the shape of birds' eggs and suggested that it was due largely to differences in the kind of nests.

P. F. SCHNEIDER.
SYRACUSE, N. Y.

THE NEW YORK ASSOCIATION OF BIOLOGY TEACHERS.

THE second regular meeting of the Association for 1902 was held in the Board of Education building, on Friday evening, April 4. There was a general discussion on the subject of 'Field Work,' introduced by Miss Kate Burnett Hixon and Miss Mary D. Womack.

G. W. HUNTER, JR.,
Secretary.

DISCUSSION AND CORRESPONDENCE.

AN AMERICAN JOURNAL OF PHYSICS.

I AM not aware whether any discussion has been published, but it must have been keenly felt by everybody associated with the physical sciences, at least, that one of the important issues in the near future is the systematization and consolidation of the journals of American science. It seems to me that what we need is a clearing house or, better, a trust of American research literature, and the pooling in the present instance will be all the more justifiable as it will be nearly pure altruism. Few of the higher order of journals—I mean those which offer non-popular scientific articles—really pay. Many of them are conducted at a loss. Perhaps for this very reason some plan of amalgamation may be feasible.

In physics the conditions* are in every way deplorable. Much, perhaps most, of our best work goes out of the country, with the result that American journals, being in a sense superfluous to the foreigner, are but little read abroad. I have no statistics; what I state are merely the convictions of more or less desultory observations; but I am afraid they are even regarded with just a little superciliousness at home.

* Much to the same effect might be said of chemical and of geological journals, though I naturally shrink from it.

There is some reason for this state of things. If we were brutally frank we might agree that a man with us is hardly eminent until he has been acknowledged as an intellectual commodity in some foreign market. From some points of view this self-distrust and lack of independent judgment is laudable; but there is also a *habit* acquired in such things that is pernicious. It is not so long ago that the Germans went tuft-hunting in France, a custom from which they awoke one day in consternation. They have not gone there since. The question to consider is whether it is not now high time for us, in turn, to awake to a spirit of scientific patriotism. One does not have to read many books to learn with what enthusiasm an Englishman, a Frenchman or a German refers to the real intellectual accomplishments of his countrymen. Is there such pride among us? I doubt it. There is rather a tendency to exhaust all other bibliography first.

Somebody has wisely said that for the English-speaking race there is but one aristocracy, and that it has taken the vigor of England to found it. Certainly the daughters of our millionaires offer much convincing if not eloquent testimony. In a somewhat similar sense, it seems to me that the aristocracy of American scientists also resides in England, though one cannot deny that the continent has some fascination. Our efficient scientific men are apt to outgrow the American Association first, then they outgrow the National Academy, and finally the country itself is altogether too small for them. Their voices reach us in this final stage, harmoniously blended, from across the water. It is all very nice as a well-devised scheme of gradation, but where is the spirit of patriotism in all this? Can we ever hope to reach intellectual maturity in the eyes of the world if we belittle the dignity of our own institutions? Self-confessed incompetency may be a virtue, but one should at least first be sure that the incompetency really exists. If Europe were to close its gates systematically to American scientific research, I believe that no greater blessing could befall us. There is enough good work done here, that if it were only properly centralized and presented in bulk, it would command the attention of the world. We should then have on our own shores what we now so frequently run for abroad.

The urgent desirability of an attempt at centralization is precisely the point which I want to accentuate. In physics we now have two prominent journals, one of them old and widely distributed, but covering a scope much beyond physics. Its contributors are naturally the older conservative physicists of the country. Recently the desirability of a journal devoted to physics alone was responded to, and a thriving magazine now exists among us, whose contributors are, as a rule, the energetic younger physicists of the country. Between the two journals, I fear, there will be an inevitable breach, for no man who has materially contributed to the older journal will be willing to see that magazine go down, and with it the accessibility of the bulk of his own work.

I mention this now, since with the advent of the Carnegie Institution there will be, almost unavoidably, another center of vigorous publication in physics. I say unavoidably at a venture, for I am quite ignorant as to any plans in that direction. There would then be further divergence, and oh, the pity of it! If, however, it should be in some way possible to unite the two existing journals,* with the consent of all interested and at their instigation, into a single *American Journal of Physics*, under the auspices of the institution, I believe that the greatest good would thereby accrue to the country. It is the national, apart from the sectional, spirit which I am anxious to see fostered. I do not know how the editors of these journals may look on such a scheme. They are my friends, though they may be shaking their fists at me now; but I am innocent of guile. If through the Carnegie Institution we could get an *American Journal of Physics*, continuous with the physical part of the *American Journal of Science* and of the *Physical Review*, definitely established, and if every

* I do not refer, of course, to journals with a unique purpose like SCIENCE, or the *Astrophysical Journal*, or *Terrestrial Magnetism*, or the Circulars of universities, etc. It is the overlapping of journals of the same kind that I have wholly in mind.

American physicist, including those who are either ashamed of their birthright, or of so vast a stature and cast in such an heroic mould that they must seek their compeers abroad—if all American physicists were to unite to publish in a national journal only, I believe the result would mark an epoch in the history of the importance of American contributions to physics. CARL BARUS.

BROWN UNIVERSITY,
PROVIDENCE, R. I.

THE CENTENARY OF HUGH MILLER.

ON the 10th of October, 1802, Hugh Miller was born at Cromarty, Scotland.

The folk of that picturesque town, whose surroundings were the inspiration of Hugh Miller's remarkable achievements in science, literature and philosophy, and the Scottish people generally, have proposed to commemorate this one-hundredth anniversary of the birth of their distinguished countryman by erecting in the town of his birth a permanent memorial of his work and worth.

It is now hoped that this proposition will meet a response sufficiently cordial and generous to justify the foundation of a Hugh Miller Institute which will serve, not alone as a resting place for the personal relics of the man, but the home of scientific collections and a library. The anniversary day, October 10, 1902, will also be commemorated by special ceremonies.

The local committee to carry into effect the centenary project has issued a circular in which the foregoing propositions are set forth, and which also contains this statement:

"The proposal has the support of the following:

"Lord Balfour of Burleigh, Secretary for Scotland; Sir Archibald Geikie, F.R.S., LL.D.; Professor Masson, LL.D.; Sir Walter Foster, M.P.; Sir John Long, M.P.; C. J. Guthrie, K.C., Sheriff of Ross and Cromarty; W. C. Smith, LL.B.; W. Robertson Nicoll, LL.D.; Arthur Bignold, Esq., M.P.; Principal Rainy, D.D.; Alexander Whyte, D.D.; Colonel Ross, C.B., of Cromarty; The Provost and Magistrates of Cromarty; Mr. James Barron, *Inverness Courier*."

No American geologist of the generation now in the full swing of its activity can have failed to come, in his early days, under the inspiration of this unique man. When textbooks of geology were few and dull, Miller portrayed in most delightful tints the beauties of the science and the charm of its philosophy. To intelligent readers of English-speaking peoples he unfolded the science in a new light; in diction his writings are a model still unattained and seldom approached by his successors; in vigor, relentless sequence, charm of anecdote and reminiscence they will never lose attractiveness and influence.

The undersigned has been asked by Mr. J. Bain, Hon. Secretary of the Hugh Miller Centenary Committee, to act as its agent in soliciting and receiving subscriptions in the United States for the end stated. Remittances will therefore be gladly received by the undersigned and acknowledgment of the same will be made by the Hon. Secretary. Checks or other orders may be made payable to

JOHN M. CLARKE,
For the Committee.

STATE HALL, ALBANY, N. Y.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. SECTION B, PHYSICS.

ATTENTION is called to the coming meeting of the American Association for the Advancement of Science, in Pittsburg, Pa., June 28 to July 3. The accessibility of Pittsburg from all parts of the country and the interest which attaches to the great manufacturing industries located there, add much to the already favorable prospects for a large and important meeting. The proposed meeting of the American Physical Society in affiliation with the American Association offers an additional attraction to physicists.

It is hoped that a full and interesting program may be secured in Section B and to this end you are requested to send titles and abstracts of papers, available for this purpose, to the Secretary of the Section. Titles should be sent in time to appear in the preliminary program which will be issued several weeks prior to the meeting.

E. F. NICHOLS, *Secretary,*
Hanover, N. H.
W. S. FRANKLIN, *Vice-President,*
South Bethlehem, Pa.

BOTANICAL NOTES.

FIG GROWING IN THE UNITED STATES.

It is doubtful whether the extent to which the fig is cultivated in this country is commonly known to botanists and others interested in plants. For this reason a recent bulletin of the United States Department of Agriculture, prepared by Dr. Gustav Eisen, is of more than ordinary interest. In it the author brings together the results of his many years of personal observation and study, added to those of growers and experimenters in California. A short chapter is given to the history and botany of the fig, and although the chapter is short many botanists will find it to be one of the best available summaries. Then follow chapters on fig culture in foreign countries, fig culture in California, the caprification of the fig, propagation, diseases, drying and curing, etc. The first fig trees in California were brought by the Franciscan missionaries a century or so ago, and from these came the 'Mission figs,' a coarse but hardy and fruitful variety. Other importations of trees were made from time to time during the latter half of the past century, when the United States Department of Agriculture took the matter in hand (1894) and imported sixty-six varieties from Italy, Spain and France. About the same time importations were made also of the Blastophagæ (*i. e.*, minute insects which aid in the pollination of the flowers), without which figs can not be grown on a large scale. Still later fig trees were imported from Asia Minor, and now we are able to grow 'Smyrna figs' successfully where the Blastophagæ are present. Details of the pollination (known as 'caprification' by fig growers) are given in the fourth chapter, and here the botanists will learn many things as to the structure and physiology of the fig which are not to be found in ordinary botanical works. Chapter XV. consists of a list, in part descriptive, of the varieties of figs, including over four hundred different kinds. Near the close of the volume the statement is made that 'California alone produces now at least one half of the quantity of dried figs consumed in the United States.'

SUMMER BOTANY AT WOOD'S HOLL.

The announcement is made that the fifteenth session of the Wood's Holl Marine Biological Laboratory is to extend from July 2 to August 13. The work in botany is to be again under the general direction of Dr. Bradley M. Davis, of the University of Chicago, which is a guarantee that it will be of the high order of excellence maintained in previous years. Courses are offered on the marine algæ, the fungi, ecology, plant physiology and cytology. The usual opportunities for investigation are offered for the benefit of those who are prepared for work of this kind. At the close of the session Dr. Cowles will conduct a four-week expedition to Mt. Katahdin and the Maine coast. The supply department of the Laboratory should be more widely known, as it undertakes to furnish type material suitable for class work in high schools and colleges. The importance of this department is probably as great to the country at large as that referred to above, since this may reach a far greater number of students in distant schools. Any agency which makes possible better work in the high schools of the country affects powerfully the work in the higher institutions, and is to be encouraged.

A JOURNAL FOR STUDENTS OF MOSSES.

Four years ago a little journal was started under the name of *The Bryologist* and continued to appear quarterly until the end of 1901. The publishers then made the announcement that with the January number it was to be issued every two months. This is a sign that the support has been such as to warrant the added outlay, and is a gratifying indication of increased interest in the plants to which the journal is devoted. Looking over the numbers of the past years one can not help considering such a journal a valuable aid to the beginner, and to the older student of mosses as well. Although we have not many professional bryologues (to use the handy French word), there should be many amateurs interested in these very interesting plants, and for such particularly this little journal must be quite indispensable. On the other hand so many new species of mosses are described in its numbers that the professional also must have access to it. Latterly the illustrations have been improved, some of the half-tones being especially fine, so that in this particular it is a desirable addition to the periodical-shelf of any botanical library. Compared with the much older French journal *Revue Bryologique,* the American publication makes a very good showing indeed, and, while perhaps not quite so technically scientific, ours is quite the superior in illustrations, printing and arrangement of matter. For this country our journal is much more useful than the French one.

THE BOTANISTS AT PITTSBURG.

IT is not too early for the botanists of the country to be planning for the Pittsburg meetings in and in connection with the American Association for the Advancement of Science, on June 30 and July 1, 2, 3. Coming so closely after the end of the college year, this should find an unusually large number of botanists free to attend the meetings, after which the practically unbroken vacation still lies before each one. On many accounts this should be a large meeting of the botanists. The place of meeting is within easy reach of both eastern and western botanists, and the region is one which should offer many botanical attractions quite out of the usual lines. If the local botanists do their duty, as doubtless they will, there should be some interesting excursions, and opportunities for the examination of recent and also of fossil vegetation. Botany includes the vegetation of the past as well as that of the present, and here will be an opportunity for studying the former which should not be allowed to pass unimproved. Botanists should not require the geologists to be the only ones interested in the plants of the earlier ages.

A NEW DISTRIBUTION OF FUNGI.

UNDER the title of 'Ohio Fungi Exsiccati,' Professor W. A. Kellerman, of the State University, Columbus, Ohio, has begun the distribution of sets of specimens of the fungi of Ohio, each accompanied by a copy of the original description of the species. Fascicles I. and II. have now appeared, and it is possible to make out the place and value such a collection will have for working botanists. In the prefatory statement accompanying the first fascicle we are told that the fascicles will appear from time to time as material may be available. "Original descriptions of all the species, or that given in connection with the first use of the binomial or technical designation, will be printed on the labels, in addition to the data usually given." Every botanist will see at once the importance of a distribution of this nature, and it is to be regretted that the edition is so small, the number of copies being but few more than those sent to working botanists. The first fascicle contains sixteen specimens, of which five are of *Puccinia,* three of *Æcidium,* four of *Cintractia,* and one each of *Peronospora, Phyllosticta, Septoria* and *Ustilago.* The second fascicle is larger, including twenty-six specimens, of which seven are species of *Puccinia,* five of *Uromyces,* three of *Ustilago,* two of *Gymnoconia,* two of *Gymnosporangium,* and one each of *Æcidium, Glœosporium, Melampsora, Piggotia, Polystictus, Stereum* and *Urocystis.* The specimens are ample and are put up in neat packets. Although these sets are intended for exchanges only, and not for sale, we are informed that a few copies may be obtained by those who wish to purchase them, at one dollar per fascicle.

CHARLES E. BESSEY.
THE UNIVERSITY OF NEBRASKA.

AERONAUTICS.

MR. WILBUR WRIGHT presented to the Western Society of Engineers, September 18, 1901, a notable paper describing experiments resembling those of Liliendahl, but decidedly more successful. Advances have been made rapidly in many directions during the past fifteen or twenty years in some directions of interest in connection with aeronautics. The motors have been greatly reduced in weight and special constructions have been made by Langley and others in which the motor weighs but ten pounds and even less per horse-power, where, not many years ago, weights of sixty pounds were exceptional and an engine weighing forty pounds per horse-power was a marvel. Little more has been done in the study of the principles of safety and stability of the flying machine than was accomplished by Liliendahl, by Pilcher and by Chanute, in Germany, in England and in the United States, respectively. It is almost ten years since Maxim mounted his machine and actually flew a short distance at high speed and with disastrous results to his machine and danger to himself, and the experiment has not been repeated. Langley's experiments and discussions have provided us with a correct knowledge of the physical and the mathematical principles involved in flight, so far as measures of lift and of head resistance are concerned, but the applied theory is still to be illustrated in any full-sized and practically useful apparatus. The steadying action of the balloon is relied upon wherever, as in the case of Myers, of Frankfort, N. Y., the oldest and most successful among pioneers in this line of development, and in that of Dumont, the inventor and exploiter, one seeks to traverse the air safely. Only when stability and permanence of stability can be insured can aviation become practicable. The experiments of the Messrs. Wright, of Dayton, O., mostly conducted at the shore on the coast of North Carolina, have seemingly advanced our knowledge greatly in this direction.

The Wright apparatus is double-decked like that of Chanute, but the endeavor was to provide for direction and balance without shifting the body of the aviator with every change in the direction and force of the wind. It was found that practice would make perfect the experimenter here, as in every other field of action; that constant practice should be provided for; that the horizontal position should be assumed by the operator and that it is actually practicable; that a small steering vane could be set in advance of the aeroplanes adopted and successfully employed in directing flight and in counteracting the fluctuating action of the wind in disturbance of the position of the center of pressure on the planes; that twisting the planes is a more effective method of meeting the changes of pressure produced by wind disturbances of small extent than any system of movement of the body.

The machine finally adopted spread 308 square feet of canvas, was 22 feet long, 7 feet high and double-decked. The wings or planes were given the section observed in the wing of the pigeon, *i. e.,* slightly curved from front to rear and with the curvature sharply increased at the leading edge in a degree determined, necessarily, by experiment. Gliding or soaring was successfully attempted with this construction, in winds of velocities ranging from 11 to 27 miles an hour, and distances were attained with small elevation at the start up to a maximum range of about 400 feet; the operator finding no special difficulty in either steering or balancing the machine. The rate of drop was as low as two feet per second in some instances.

These investigations have probably disclosed a method of study of the action of the aerodrome which is comparatively safe, which permits the investigator to dispense with a motor if he so desires during the preliminary work of tracing out the principles underlying stability and safe operation of the aviator in a moving atmosphere. The work is a distinct contribution to existing knowledge in this fascinating field of research.

R. H. T.

U. S. CIVIL SERVICE EXAMINATIONS.

The Civil Service Commission announces an examination on May 6 and 7, for positions in the Philippine service of agricultural chemist, analytical chemist, physical chemist, physiological chemist and pharmacologist with salaries of $1,500 to $1,800. In announcing this examination, the Commission sends the following statement:

These examinations offer an excellent opportunity to enter a service which has many attractive features and to see a most interesting part of the world. The Philippine Service is classified, and the law contemplates promotions on the basis of merit from the lowest to the highest positions.

Thirty days' leave of absence is granted each year, exclusive of Sundays and holidays, and those employees who are promoted to $1,800 per annum are entitled to thirty-five days, or about forty days including Sundays and holidays. Leave is also cumulative, and at the end of three years those who have to their credit cumulative leave for two years may visit the United States without having the time in going to and returning from San Francisco charged against their leave. China and Japan are near at hand and are favorite places to visit during vacations. Saturday is a half-holiday.

Appointees will be required to pay their traveling expenses to San Francisco, but the Government furnishes them transportation free of charge on its transports from that point to Manila, but exacts a charge of $1.50 a day for meals while en route, which is returned to the appointee upon his arrival at Manila. Employees who are residents of the United States at the time of their appointment shall, after six months' satisfactory service, be reimbursed for their traveling expenses from the place of their residence to the point of embarkation for Manila.

The Philippine climate is good, and nearly all of the employees are in excellent health. Medical attendance, when required, is furnished employees without cost. Good accommodations (room and board) can be secured in Manila for about $35 a month, while employees assigned outside of Manila obtain cheaper accommodations. The office accommodations in Manila are good, and the work is done under pleasant conditions.

The Commission also invites attention to the examination which will be held on April 22, for the position of assistant (scientific), Department of Agriculture.

This examination is designed for the purpose of securing persons who are qualified for the scientific work of the Department of Agriculture. Applications will be received from graduates of colleges or universities where it is shown that the applicants have pursued courses of instruction which will qualify them for the scientific work of the Department of Agriculture. Each applicant will be required to show the scope of the studies pursued and the length of time devoted to them, and his standing in each of the studies. At the time the application is filed the applicant must also submit therewith a thesis prepared by himself upon some special subject, either technical or scientific, selected by the applicant, relating to the work he is qualified to perform, or, in lieu thereof, such literature on the special subject selected as he has published over his own signature.

In connection with this examination applicants may also qualify as scientific aids in the Department of Agriculture, in order to qualify for which, however, applicants must be graduates of colleges receiving the benefits of grants of land or money from the United States, and submit with their applications the material as set forth in section 73 of the Manual. In the case of applicants for assistant it is not necessary that they be graduates of colleges receiving the benefits of grants of land or money from the United States, but they must submit with their applications the matter required by the examination for scientific aid. In addition to the foregoing, the applicants may be examined in any of the following subjects: Chemistry, (*a*) analytical, (*b*) agricultural, (*c*) industrial; physics, (*a*) especially as applied to meteorology, (*b*) soils, (*c*) irrigation; botany, plant physiology and pathology, horticulture; bacteriology (plant and animal); forestry; zoology; ornithology and mammalogy; entomology; physiology and nutrition of man; animal pathology; animal production and dairying; rural engineering, specially as applied to road making and irrigation; practice of agriculture; agricultural statistics; library science and methods.

From the eligibles resulting from this examination it is expected that certification will be made to positions in the Department of Agriculture along the lines indicated, and to other departments where similar qualifications are desired.

SCIENTIFIC NOTES AND NEWS.

THE Secretary of War has sent to the House a recommendation that Surgeon-General Sternberg be granted the rank of major-general before his retirement on reaching the age limit June next.

THE University of Edinburgh has conferred its LL.D. on Professor William James, the eminent psychologist of Harvard University, and on Dr. J. G. Schurman, president and formerly professor of philosophy at Cornell University.

PROFESSOR SIMON NEWCOMB will leave New York City for Naples on April 19.

PROFESSOR WILLIAM M. PUFFER, of the Massachusetts Institute of Technology, has returned to Boston after a visit to Europe to inspect foreign laboratories, in view of the erection of the new laboratories of electrical engineering at the institute.

Dr. A. Graham Bell, president of the National Geographical Society, gave a dinner on April 12 to Mr. C. E. Borchgrevink, the antarctic explorer.

Dr. Andrew S. Draper, president of the University of Illinois, has been thrown from a carriage and seriously injured. One of his legs has been amputated and it is feared that his condition is serious.

King Edward has approved the award of a civil list pension of £75 per annum to Mrs. J. Viriamu Jones, widow of Principal Jones, the eminent physicist, in recognition of his services to higher education in Wales.

Professor Vambery, the well-known ethnologist of Buda Pesth, has celebrated his seventieth birthday.

The Institute of France has awarded from the Desbrousses foundation 20,000 frs. to M. Curie for his researches on radium.

Dr. W. W. Keen, professor of surgery in the Jefferson Medical College, Philadelphia, attended the recent meeting of the German Surgical Association in Berlin and was elected an honorary member of the Association.

Dr. Seaman A. Knapp has just returned from a nine months' trip as agricultural explorer for the Department of Agriculture. He visited Japan, China, the Philippines, and India, returning *via* Hawaii, where he spent a few days. The main object of his trip was the study of rice, although considerable attention was also given to other subjects bearing upon certain phases of the development of agriculture in the southern States.

Under the leadership of Mr. O. F. Cook, in charge of its tropical work, the Department of Agriculture has despatched an expedition to Guatemala and southern Mexico for the purpose of studying tropical agriculture as practiced in those countries. Rubber and coffee culture are to receive particular attention, and many interesting facts concerning the botany and the commercial cultivation of the Central American rubber tree (*Castilloa elastica*) are anticipated.

Professor C. H. Eigenmann has returned from a trip to the western part of Cuba in search of blind fishes. He was accompanied by Mr. Oscar Riddle, a senior in the Indiana University, as assistant and interpreter. The results of the trip are highly satisfactory. Many specimens of both species of blind fishes known from Cuba were secured. Their known distribution was widely extended. It has been found that the blind fishes which inhabit the caves of the interior and are immigrants from the abysmal regions of the ocean bring forth living young about an inch long. At the time of birth the eyes are well developed and may be functional; they degenerate and become covered with a thick layer of tissue with age. The fishes are becoming readjusted to living in the light in the sink holes along the courses of the underground waters.

Marshall H. Saville, curator of Central American and Mexican archeology in the American Museum of Natural History, has been exploring in Oaxaca, Mexico, since last December, under the auspices of the duc de Loubat. He has already been very successful and has found, among other things at Cuilapa, seven tombs, about a dozen stone graves, two stone drains and two lines of terra cotta tubing, as well as many jade specimens. He will return about June 1.

Nature learns from the *Victorian Naturalist* that the Central Australian expedition under the leadership of Professor Baldwin Spencer and Mr. F. J. Gillen reached the Macarthur river, Northern Territory, but was detained at Borroloola, a small township about fifty miles from the mouth of the river, owing to the foundering of the steamer which should have taken them on to Port Darwin as previously arranged. The matter of affording the expedition some relief was brought before the Commonwealth Parliament without result. However, the Premier of Victoria (Hon. A. J. Peacock) placed himself in communication with the Queensland Government, and it was arranged to send a small steamer from Normanton and bring the party on to that port, from whence there is frequent communication with eastern Australia.

Lord and Lady Kelvin have accepted an invitation to a reception at Columbia University on Monday evening, April 21. The reception is offered by the American Institute of Electrical Engineers and other scientific societies concerned with subjects to which Lord Kelvin has contributed, the committee of arrangements being as follows: Dr. Francis B. Crocker, *Chairman,* Past Pres. A. I. E. E.; Mr. Calvin W. Rice, *Secretary,* Chairman Com. on Meetings, A. I. E. E.; Dr. Robert S. Woodward, Past Pres. A. A. A. S. and Am. Math. Soc.; Mr. Frederick P. Keppel, Sec. Columbia University; Dr. Arthur G. Webster, Vice-Pres. Am. Phys. Society; Professor James McKeen Cattell, Pres. N. Y. Academy of Science; Mr. T. Commerford Martin, Past Pres. A. I. E. E. The reception will continue from 8:30 to 11 p.m., with addresses at about 9:30 p.m. by President Nicholas Murray, Butler, Columbia University, and eminent men of science representing the societies, to which it is expected that Lord Kelvin will reply.

The Senate has confirmed the following executive nominations: Omenzo G. Dodge, to be a professor of mathematics in the Navy, with rank of commander, from the 17th day of December, 1899; Stimson J. Brown, to be a professor of mathematics in the Navy with the rank of captain, from the 25th day of August, 1900; Henry M. Paul, to be a professor of mathematics in the Navy with the rank of commander, from the 25th day of August, 1900; Edward K. Rawson, to be a professor of mathematics in the Navy with the rank of captain, from the 25th day of November, 1900; Aaron N. Skinner, to be a professor of mathematics in the Navy with the rank of commander, from the 25th day of November, 1900; Philip R. Alger, to be a professor of mathematics in the Navy with the rank of commander, from the 22d day of May, 1899.

The Naples Academy has awarded its prize for natural sciences for 1901 to Dr. Marussia Bakunin, the authoress of papers dealing with stereochemistry.

Dr. A. H. Doty, health officer of the Port of New York, has received from the directors of the Pan-American Exposition at Buffalo the award of a gold medal for his exhibit on sanitation.

President Roosevelt has signed the bill restoring Dr. Edward Kershner to his rank of medical inspector in the navy. In accordance with the provisions of this act, the President has appointed Dr. Kershner to be medical inspector in the navy on the retired list.

Sir William Church has been elected for the fourth time president of the Royal College of Physicians, London.

Dr. William Hunter, formerly assistant bacteriologist at the London Hospital, has been appointed by the Colonial Office to be Government bacteriologist at Hong Kong.

The death is announced of Mr. Patrick T. Manson, son of Dr. Patrick Manson, on Christmas Island, whither he had gone to investigate the cause and treatment of beriberi, on behalf of the London School of Tropical Medicine.

M. Emile Renou, founder and director of the Meteorological Observatory at St. Mauri, died in Paris on April 7, aged eighty-seven. He was the author of numerous geographical, geological and meteorological works, and made an important scientific expedition to northern Africa in 1840.

Mr. George Fergusson Wilson, F.R.S., the author of researches on chemistry, and also known as a horticulturist, died on March 28, aged eighty years.

There have also died Dr. Richard Schumacher, astronomer at the Kiel Observatory, at the age of seventy-six years; Dr. Arnulf Schurtel, professor of mining in the School of Mining at Freiburg, aged sixty-one years, and Dr. E. Miller, docent in physics in the University at Erlangen.

The provision for the U. S. Geological Survey in the sundry civil service bill, as passed by the House, is $960,570. The debate in the House on the occasion of the passing of this item is of much interest as showing how highly the work of the survey is appreciated. The appropriation was increased by $80,000, while the House was sitting as committee of the whole.

Dr. S. Weir Mitchell has established a prize of $50 in the School of Biology at the University of Pennsylvania, for an original investigation on the autumnal coloration of plants.

In pursuing its purpose to encourage the study of local natural history the Springfield Science Museum offers two prizes for collections of beetles. These prizes are open to children who are pupils below high school grade in any Springfield school. Specimens to show how beetles and notes are to be prepared may be seen at the museum, and two talks on 'Beetles, and How to Collect Them,' have been arranged.

The French Chamber has voted a subsidy of 25,000 frs. for the International Bureau for the unification of physiological instruments established at Paris by Professor Marey.

The Prussian government offers three prizes of the value of 5,000, 3,000 and 2,000 Marks for the best instrument for the measurement of the pressure of the wind; and a further prize of 3,000 Marks will be awarded if the instrument proves serviceable after long use. The plans must be submitted to the *Deutsche Seewarte* in Hamburg before April 15, 1903. The competition is open to foreigners.

King Edward, who is patron of the National Antarctic expedition, has contributed £100 towards the funds for the equipment of the relief ship, which must sail in June next.

The seventy-fourth meeting of German Naturalists and Physicians will be held at Carlsbad, beginning on September 21.

Dr. Lederle, president of the New York City Department of Health, has asked the board of estimate and apportionment for $1,025,000 with which to provide repairs and new hospitals for the treatment of contagious diseases.

The House of Representatives has passed a bill making the petrified forest of Arizona a national park.

A bill creating the National Appalachian Forest Reserve has been reported to the House. It authorizes the Secretary of Agriculture to purchase not more than 4,000,000 acres of mountain and forest lands in Virginia, West Virginia, North Carolina, South Carolina, Georgia, Alabama and Tennessee for a forest reserve, at a cost not exceeding $10,000,000, of which $2,000,000 is appropriated by the bill.

A bill has been introduced in the Senate authorizing the establishment of a biological station on the Great Lakes, under the control of the United States Commission of Fish and Fisheries.

A bill has been introduced in the Senate by Senator Depew proposing that the United States erect a building in Paris, at a cost not exceeding $250,000, to be known as the American National Institute, on ground donated by the Municipal Council.

The physicians of Chicago are planning to erect a building for a meeting place and as a club house. It is proposed to cooperate with the John Creerar Library in the establishment of a medical library.

The growing demand for qualified teachers of nature study in the public schools has led to the foundation of a new summer school under the direction of members of the faculty of the Massachusetts Institute of Technology. The Sharon Summer School, as it is called, is designed to furnish teachers and lovers of nature with sound training in the principles of natural science and a practical knowledge of the commoner forms of living things, rather than to provide specialists with opportunities for research. The curriculum provides for fundamental work in physiography and general biology, and for elective courses on trees, wild flowers, birds, insects, mammals and seashore life. Laboratory facilities are available at the Institute of Technology, and an opportunity for outdoor study and experimentation is furnished by the control of 300 acres of natural country, in the town of Sharon, where most of the field work of the school will be carried on. Information about the course, which will be given during the four weeks following July 9, may be obtained from G. W. Field, director, or C. E. A. Winslow, secretary, Sharon Summer School, Mass. Inst. Tech., Boston. Among other members of the faculty of the school are Professor G. H. Barton of the Institute, Mr. J. G. Jack of the Arnold Arboretum, Mr. A. H. Kirkland and Mr. Wm. Lyman Underwood.

THE department of physics of Indiana University held a conversazione on three evenings during the recent meeting of the Southern Indiana Teachers' Association. Each demonstration required ten minutes. The following subjects were given: 'An improved interrupter with an automatic circuit maker,' used to operate X-ray tubes of highest power; 'Motion,' the bicycle wheel gyroscope, compound pendulum, etc.; the 'Nernst lamp' (the exhibit was loaned by the Nernst Lamp Co. of Pittsburg); the 'Cooper-Hewitt Vapor Lamp,' given by the consent of the inventor; the 'Speaking arc'; and 'Wireless telegraphy.' The department was especially successful in demonstrating the Hewitt lamp, considering how difficult it is to obtain the proper vacuum conditions.

THE Peary Arctic Club, having found the steam barque *Windward* unserviceable for further work in the north, has decided to install new engines and boilers. The work will be completed by June 20 and departure will be taken immediately for the north, about a month earlier than usual in order that advantage may be taken of the conditions in Smith Sound, which experience has shown are likely to be more favorable early in the season. The *Windward* expects to effect a junction with Peary, either at Etah, on the eastern side, or at Cape Sabine, his headquarters of last year on the westward side of Smith Sound, his journey to the pole and return having by the time of its arrival been accomplished.

Nature states that in connection with the survey of British lakes provided for by the Pullar Trust, Sir John Murray has rented Rannoch Lodge, standing at the west end of Loch Rannoch, from now until the commencement of the shooting season. In the first week of April the following gentlemen will join him and will be associated with him in the work, viz.: Mr. R. M. Clark, Aberdeen; Mr. T. N. Johnston, Edinburgh; Mr. James Parsons, London, and Mr. James Chumley, Edinburgh. Other appointments will be made later in the season. Sir Robert Menzies, who has taken a great interest in these investigations, and has placed boats, etc., at Sir John Murray's disposal for carrying on the work, has said that all Highland proprietors should render any assistance in their power to the survey by offering the use of boats. It is intended to include within the scope of the survey, in addition to the systematic physical and biological investigations, observations regarding the oscillations in the level of the water (phenomena called 'seiches' by Professor Forel) by means of self-registering 'limnographs,' which will be set up on the shores of the larger lakes. The first limnograph is now in process of construction in Geneva under the personal supervision of Professor Ed. Sarasin, of Geneva. It will be remembered that Mr. Laurence Pullar, of Bridge of Allan, has set aside funds to aid in carrying out this survey, as a memorial to his son, the late Mr. Fred. P. Pullar, who was engaged (in collaboration with Sir John Murray) in a systematic survey of the Scottish lakes at the time of his accidental death in February of last year.

WE learn from the London *Times* that Mr. Consul Neville Rolfe in his last report from Naples states that the subject of mosquitoes and malaria is still attracting considerable attention in Italy, more especially in the Naples district, where a large area is subject to malaria. Next to Sardinia, the province of Basilicata is the largest malarious tract in Italy, and therefore, the most interested in the extermination of the disease. The most fatal season occurs in August and September, but the further south the longer does the dangerous season continue, so that in Basilicata security can rarely be enjoyed or reckoned upon until October is past. Mosquitoes are not transported by wind, as has been often supposed, but they move from place to place on or about men or animals, and on any baggage which attracts them. This explains isolated cases and epidemics which have occurred in places distant alike from marshes and stagnant water. Some interesting cases of fever, owing to this cause, occurred at the station of

Termini, near Rome, the cases having probably originated from the mosquitoes conveyed by the Terracina train, which crosses the most deadly part of the Pontine marshes. There is a special aniline dye which when diluted even to the extent of 0.00031 per mil., is said to kill the larvæ. The well-known pastilles and powder, similar to ordinary insect-powder, which can either be burnt or distributed by means of bellows, are also mentioned. This powder is made of the flowers of the *pyrethrum roseum*, a herb extensively grown on the Dalmatian coast, the cultivation of which is being tried near Ceprano, a town about half-way between Naples and Rome. It is found that valerian root, powered and mixed with the other, renders it more efficacious. Experiments were made during last summer by Professor Grassi to combat the malady by the use of drugs. In this he has obtained a great measure of success, but the expense of the drugs and the difficulty of getting the large quantity necessary taken at regular times will form an insuperable difficulty in the case of the peasantry. Having selected one of the most malarious places in Italy, Ostia, at the mouth of the Tiber, Professor Grassi and his staff have administered six pills a day to adults, and a proportionate dose to children, the pills being composed of a compound called 'esanofele,' a harmless drug composed of quinine, arsenic, iron and bitter herbs. Dr. Grassi speaks highly of the results, and the tabulated statistics of the Ostia treatment appear very favorable.

UNIVERSITY AND EDUCATIONAL NEWS.

The litigation over the will of the late Thomas Armstrong, of Plattsburgh, N. Y., in which he bequeathed his entire estate, valued at $250,000, to Union College, has been terminated by amicable settlement outside of court. The college officials agreed to give the son of the testator one half of the estate.

Columbia University has received a bequest of $50,000 from Mrs. Lena Currier, subject to a life interest. The money is to form a fund for the purchase of books.

Washington University has let the contracts for building three additional buildings, a library, a dormitory, and a gymnasium, the approximate cost of which will be $550,000.

At the annual meeting of the board of regents of the University of Nebraska, the Omaha Medical College was affiliated. Two years of the medical work will be given in Lincoln and the clinical years at Omaha. The work will be strengthened at all points, and it is believed that the combination will result in better opportunities for medical education in this region. Dr. Henry B. Ward of the university was elected dean of the school.

At a meeting of the board of directors of the Agricultural and Mechanical College of Texas, held in Waco, April 7, 1902, David E. Houston, M.A., professor of political science in the University of Texas, was elected president. The newly elected president is thirty-six years of age, a graduate of South Carolina College in 1887, and a M.A. of Harvard University in 1892. In 1894 he was elected adjunct professor of political science in the University of Texas; advanced to associate professor in 1897; promoted to the full title in 1899, and at the same time made dean of the academic faculty. That his reputation is more than local is shown by the fact that he has already given a course of lectures before the officers and students of the Johns Hopkins University and further that his literary productions have been sought by the leading publications of our country.

Mr. J. Stuart Horner has been appointed by the corporation of McGill University its honorary representative in England. It is planned to hold an entrance examination in London next June.

At Harvard University, Dr. Charles Palache has been appointed assistant professor of mineralogy, and Dr. R. B. Dixon instructor in anthropology.

Mr. George P. Bacon, instructor in mathematics and astronomy in Beloit College has been appointed professor of physics in Wooster University.

Dr. Albert R. Sweetser has been appointed professor of biology in the State University of Oregon.

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, APRIL 25, 1902.

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INAUGURAL ADDRESS OF PRESIDENT BUTLER, OF COLUMBIA UNIVERSITY.

FOR these kindly and generous greetings I am profoundly grateful. To make adequate response to them is beyond my power. The words that have been spoken humble as well as inspire. They express a confidence and hopefulness which it will tax human capacity to the utmost to justify, while they picture a possible future for this University which fires the imagination and stirs the soul. We may truthfully say of Columbia, as Daniel Webster said of Massachusetts, that her past, at least, is secure; and we look into the future with high hope and happy augury.

To-day it would be pleasant to dwell upon the labors and the service of the splendid body of men and women, the University's teaching scholars, in whose keeping the honor and the glory of Columbia rest. Their learning, their devotion, and their skill call gratitude to the heart and words of praise to the lips. It would be pleasant, too, to think aloud of the procession of men which has gone out from Columbia's doors for well-nigh a century and a half to serve God and the State; and of those younger ones who are even now lighting the lamps of their lives at the altar-fires of eternal youth. Equally pleasant would it be to pause to tell those who labor with us—North, South, East and West—and our nation's schools, higher and lower alike, how much they have taught us, and by what bonds of affection and fellow-service we are linked to them.

All these themes crowd the mind as we reflect upon the significance of the ideals which we are gathered to celebrate; for this is no personal function. The passing of position or power from one servant of the university to another is but an incident; the university itself is lasting, let us hope eternal. Its spirit and its life, its usefulness and its service, are the proper subjects for our contemplation to-day.

The shifting panorama of the centuries reveals three separate and underlying forces which shape and direct the higher civilization. Two of these have a spiritual character, and one appears to be, in part at least, economic, although clearer vision may one day show that they all spring from a common source. These three forces are the church, the state and science, or, better, scholarship. Many have been their interdependences and manifold their intertwinings. Now one, now another, seems uppermost. Charlemagne, Hildebrand, Darwin are central figures, each for his time. At one epoch these forces are in alliance, at another in opposition. Socrates died in prison, Bruno at the stake. Marcus Aurelius sat on an emperor's throne, and Thomas Aquinas ruled the mind of a universal church. All else is tributary to these three, and we grow in civilization as mankind comes to recognize the existence and the importance of each.

It is commonplace that in the earliest family community, church and state were one. The patriarch was both ruler and priest. There was neither division of labor nor separation of function. When development took place, church and state, while still substantially one, had distinct organs of expression. These often clashed, and the separation of the two principles was thereby hastened. As yet scholarship had hardly any representatives. When they did begin to appear, when science and philosophy took their rise, they were often prophets without honor, either within or without their own country, and were either misunderstood or persecuted by church and state alike. But the time came when scholarship, truth-seeking for its own sake, had so far justified itself that both church and state united to give it permanent organization and a visible body. This organization and body was the university. For nearly ten centuries—a period longer than the history of parliamentary government or of Protestantism—the university has existed to embody the spirit of scholarship. Its arms have been extended to every science and to all letters. It has known periods of doubt, of weakness and of obscurantism; but the spirit which gave it life has persisted and has overcome every obstacle. To-day, in the opening century, the university proudly asserts itself in every civilized land, not least in our own, as the bearer of a tradition and the servant of an ideal without which life would be barren and the two remaining principles which underlie civilization robbed of half their power. To destroy the university would be to turn back the hands upon the dial of history for centuries; to cripple it is to put shackles upon every forward movement that we prize—research, industry, commerce, the liberal and practical arts and sciences. To support and enhance it is to set free new and vitalizing energy in every field of human endeavor. Scholarship has shown the world that knowledge is convertible into comfort, prosperity and success, as well as into new and higher types of social order and of spirituality. 'Take fast hold of instruction,' said the wise man; 'let her not go; keep her; for she is thy life.'

Man's conception of what is most worth knowing and reflecting upon, of what may best compel his scholarly energies, has changed greatly with the years. His earliest impressions were of his own insignificance and of the stupendous powers and forces by which he was surrounded and ruled. The heavenly fires, the storm-cloud and the thunderbolt, the rush of waters and the change of seasons, all filled him with an awe which straightway saw in them manifestations of the superhuman and the divine. Man was absorbed in nature, a mythical and legendary nature, to be sure, but still the nature out of which science was one day to arise. Then at the call of Socrates, he turned his back on nature and sought to know himself, to learn the secrets of those mysterious and hidden processes by which he felt and thought and acted. The intellectual center of gravity had passed from nature to man. From that day to this the goal of scholarship has been the understanding of both nature and man, the uniting of them in one scheme or plan of knowledge, and the explaining of them as the offspring of the omnipotent activity of a creative spirit, the Christian God. Slow and painful have been the steps toward the goal, which to St. Augustine seemed so near at hand, but which has receded through the intervening centuries as problems grew more complex and as the processes of inquiry became so refined that whole worlds of new and unsuspected facts revealed themselves. Scholars divided into two camps. The one would have ultimate and complete explanations at any cost; the other, overcome by the greatness of the undertaking, held that no explanation in a large and general way was possible. The one camp bred sciolism; the other narrow and helpless specialization.

At this point the modern university problem took its rise; and for over 400 years the university has been striving to adjust its organization so that it may most effectively bend its energies to the solution of the problem as it is. For this purpose the university's scholars have unconsciously divided themselves into three types or classes—those who investigate and break new ground; those who explain, apply, and make understandable the fruits of new investigation; and those philosophically minded teachers who relate the new to the old, and, without dogma or intolerance, point to the lessons taught by the developing human spirit from its first blind gropings toward the light on the uplands of Asia or by the shores of the Mediterranean, through the insights of the world's great poets, artists, scientists, philosophers, statesmen and priests, to its highly organized institutional and intellectual life of to-day. The purpose of scholarly activity requires for its accomplishment men of each of these three types. They are allies, not enemies; and happy the age, the people, or the university in which all three are well represented. It is for this reason that the university which does not strive to widen the boundaries of human knowledge, to tell the story of the new in terms that those familiar with the old can understand, and to put before its students a philosophical interpretation of historic civilization, is, I think, falling short of the demands which both society and university ideals themselves may fairly make.

Again a group of distinguished scholars in separate and narrow fields can no more constitute a university than a bundle of admirably developed nerves without a brain and spinal cord can produce all the activities of the human organism. It may be said, I think, of the unrelated and unexplained specialist, as Matthew Arnold said of the Puritan, that he is in great danger; because he imagines himself in possession of a rule telling him the *unum necessarium*, or one thing needful, and that he then remains satisfied with a very crude conception of what this rule really is, and what it tells him, and in this dangerous state of assurance and self-satisfaction proceeds to give full swing to a number of the instincts of his ordinary self. And these instincts, since he is but human, are toward a general view of the world from the very narrow and isolated spot on which he stands. Only the largest and bravest spirits can become great specialists in scholarship and resist this instinctive tendency to hasty and crude philosophizing. The true scholar is one who has been brought to see the full meaning of the words development and history. He must, in other words, be a free man as Aristotle understood the term. The free man is he who has a largeness of view which is unmistakable and which permits him to see the other side; a knowledge of the course of man's intellectual history and its meaning; a grasp of principles and a standard for judging them; the power and habit of reflection firmly established; a fine feeling for moral and intellectual distinctions; and the kindliness of spirit and nobility of purpose which are the support of genuine character. On this foundation highly specialized knowledge is scholarship; on a foundation of mere skill, deftness or erudition, it is not. The university is concerned with the promotion of the true scholarship. It asks it in its scholars who teach; it inculcates it in its scholars who learn. It believes that the languages, the literatures, the art, the science and the institutions of those historic peoples who have successively occupied the center of the stage on which the great human drama is being acted out, are full of significance for the world of to-day; and it asks that those students who come to it to be led into special fields of inquiry, of professional study or of practical application, shall have come to know something of all this in an earlier period of general and liberal studies.

Mr. Emerson's oration before the oldest American society of scholars, made nearly sixty-five years ago, is the magnetic pole toward which all other discussions of scholarship must inevitably point. His superb apology for scholarship and for the scholar as Man Thinking opened an era in our nation's intellectual life. The scholar as Mr. Emerson drew him is not oppressed by nature or averse from it, for he knows it as the opposite of his soul, answering to it part for part. He is not weighted down by books or by the views which Cicero, which Locke, which Bacon have given, for he knows that they were young men like himself when they wrote their books and gave their views. He is not a recluse or unfit for practical work, because he knows that every opportunity for action passed by is a loss of power. The scholar, in short, as the university views him, and aims to conserve and to produce him and his type, is a free man, thinking and acting in the light of the world's knowledge and guided by its highest ideals.

In this sense the university is the organ of scholarship, and in this sense it aims to be its embodiment. The place of scholarship has been long since won, and is more widely recognized and acknowledged than ever before. The church and the state, which first gave it independence, are in close alliance with it and it with them. The three are uniting in the effort to produce a reverent, well-ordered and thoughtful democratic civilization in which the eternal standards of righteousness and truth will increasingly prevail.

But a university is not for scholarship alone. In these modern days the university is not apart from the activities of the world, but in them and of them. It deals with real problems, and it relates itself to life as it is. The university is for both scholarship and service; and herein lies that ethical equality which makes the university a real person, bound by its very nature to the service of others. To fulfil its high calling the university must give, and give freely, to its students, to the world of learning and of scholarship, to the development of trade, commerce and industry, to the community in which it has its home, and to the state and nation whose foster-child it is. A university's capacity for service is the rightful measure of its importunity. The university's service is to-day far greater, far more expensive, and in ways far more numerous than ever before. It has only lately learned to serve, and hence is has only lately learned the possibilities that lie open before it. Every legitimate demand for guidance, for leadership, for expert knowledge, for trained skill, for personal services, it is the bounden duty of the university to meet. It may not urge that it is too busy accumulating stores of learning and teaching students. Serve it must, as well as accumulate and teach, upon pain of loss of moral power and impairment of usefulness. At every call it must show that it is

Strong for service still and unimpaired.

The time-old troubles of town and gown are relics of an academic aloofness which was never desirable and which is no longer possible.

In order to prepare itself for efficient service the university must count in its ranks men competent to be the intellectual and spiritual leaders of the nation and competent to train others for leadership. Great personalities make great universities. And great personalities must be left free to grow and express themselves, each in his own way, if they are to reach a maximum of efficiency.

Spiritual life is subject neither to mathematical rule nor to chemical analysis. Rational freedom is the goal towards which the human spirit moves, slowly but irresistibly, as the solar system towards a point in the constellation Hercules; and national freedom is the best method for its movement. Moreover, different subjects in the field of knowledge and its applications require different approach and different treatment. It is the business of the university to foster each and all. It gives its powerful support to the learned professions, whose traditional number has of late been added to by architecture, engineering and teaching, all of which are closely interwoven with the welfare of the community. It urges forward its investigators in every department and rewards their achievements with the academic laurel. It studies the conditions under which school and college education may best be given, and it takes active part in advancing them. In particular, it guards the priceless treasure of that liberal learning which I have described as underlying all true scholarship, and gives to it full-hearted care and protection. These are all acts of service direct and powerful.

The university does still more. It lends its members for expert and helpful service to nation, state, and city. University men are rapidly mobilized for diplomatic service, for the negotiation of important treaties, for the administration of dependencies, for special and confidential service to the Government, or some department of it, and, the task done, they return quietly to the ranks of teaching scholars, as the soldiers in the armies of the war between the States went back to civil life without delay or friction. These same university men are found foremost in the ranks of good citizenship everywhere and as laymen in the service of the Church. They carry hither and yon their practical idealism, their disciplined minds, and their full information, and no human interest is without their helpful and supporting strength. It is in ways like these that the university has shown, a thousand times, that sound theory and correct practice are two sides of a shield. A theorist is one who sees, and the practical man must be in touch with theory if he is to see what it is that he does.

What the future development of the great universities is to be perhaps no one can foresee. But this much is certain. Every city which because of its size or wealth or position aims to be a center of enlightenment and a true world-capital must be the home of a great university. Here students and teachers will throng by the mere force of intellectual gravitation, and here service will abound from the mere host of opportunities. The city, not in its corporate capacity, but as a spiritual entity, will be the main support of the university, and the university, in turn, will be the chief servant of the city's higher life. True citizens will vie with each other in strengthening the university for scholarship and for service. In doing so they can say, with Horace, that they have builded themselves monuments more lasting than bronze and loftier than the pyramids reared by kings, monuments which neither flood nor storm nor the long flight of years can overthrow or destroy. Sir John de Balliol, doing a penance fixed by the Abbot of Durham; Walter de Merton, making over his minor house and estates to secure to others the advantages which he had not himself enjoyed; William of Wykeham, caring generously for New College and for Winchester school; John Harvard, leaving half his property and his library to the infant college by the Charles, and Elihu Yale, giving money and his books to the collegiate school in New Haven, have written their names on the roll of the immortals and have conferred untold benefits upon the human race. Who were their wealthy, powerful, and high-born contemporaries? Where are they in the grateful esteem of the generations that have come after them? What service have they made possible? What now avails their wealth, their power, their high birth? Balliol, Merton, Harvard, Yale are names known wherever the English language is spoken, and beyond. They signify high purpose, zeal for learning, opposition to philistinism and ignorance. They are closely interwoven with the social, the religious, the political, the literary history of our race. Where else are there monuments such as theirs?

Scholarship and service are the true university's ideal. The university of to-day is not the 'home of lost causes, and forsaken beliefs, and unpopular names, and impossible loyalties.' It keeps step with the march of progress, widens its sympathies with growing knowledge, and among a democratic people seeks only to instruct, to uplift and to serve, in order that the cause of religion and learning, and of human freedom and opportunity, may be continually advanced from century to century and from age to age.

TYPES AND SYNONYMS.

From the literary standpoint the existence of many names for the same or closely similar objects or ideas is thought to enrich language and to conduce to facility, elegance and accuracy of expression. In systematic biology, however, synonyms figure as superfluous designations which furnish no useful or welcome additions to the vocabulary of science; biological synonymy is a most burdensome legacy of ignorance and confusion, requiring constant revision and readjustment, and yielding no adequate returns for the labor which the naturalist must expend in historical or merely antiquarian research. Indeed, the study of systematic biology appears to be little more than a 'battle of the synonyms' when its most conspicuous result is the replacement of long-used names by others whose tenure is guaranteed only by personal opinions and individual methods of literary and historical criticism.

It is true that several independent descriptions of the same animal or plant often furnish more complete and satisfactory knowledge than could have been expected from any one naturalist, but not even this consideration will reconcile us to the indefinite multiplication of names by those more anxious to announce discoveries than to contribute to the permanent progress of scientific knowledge. As in general literature, it may sometimes be permissible to coin new scientific terms to avoid the confusion likely to arise from the use of those of doubtful application, but the tendency for the last half century has been distinctly in the direction of a divorce of systematic from general literature by holding to the permanent use of old names in preference to the admission of new and improved designations, the substitution of which had previously been a very common practice.

INSTABILITY UNDER LITERARY METHODS.

In dealing with specific names both zoologists and botanists now recognize that nomenclatorial stability requires adherence to a definite law of priority, with a fixed initial date and other regulations necessary for securing uniform interpretation and eliminating the variable factor of individual opinion. The wisdom and utility of these laws are now generally considered obvious, although there were many objections at first, and even the great Bentham took the ground that as the names of plants consist of two parts, a law of priority could be applied only to 'correct combinations.' By a similar effort of casuistry an effective priority for genera is now held to be impossible by systematists who still work under the theory that we are not attempting to name the natural groups of plants and animals, but are merely attaching names to varying concepts and definitions, the applications of which are to be determined by a historical study of the various interpretations and arguments of previous students. Some counsel a strict adherence to the intention of the original author, while others are accustomed to accept the usage of subsequent writers, so that it not infrequently happens that a name is used for a group of species quite distinct from those at first placed under it. An instance of this kind is that of the royal palm,* where the failure to hold the names *Euterpe* and *Oreodoxa* to their original species has complicated the synonymy and distribution of at least six genera.

Such usage accords well with the literary vicissitudes of words and definitions, but it is obviously not likely to conduce to the precision and stability required in scientific terms. The method of elimination, under which interpretations of genera are limited by the original content of

* Already noted in SCIENCE, N. S., 12:479, and in *The Bulletin of the Torrey Botanical Club*, 28:549.

The name *Oreodoxa* was originated by Willdenow for two Venezuelan species, the first of which, *O. acuminata*, has been referred to the older genus *Euterpe* while the second, *O. praemorsa*, has been used by Wendland as the basis of his genus *Catoblastus*, the name *Oreodoxa* being transferred to still a third group, no species of which was known to the author of *Oreodoxa*. The extent of the carelessness induced by the method of concepts is further illustrated by the fact that the genus *Euterpe*, to which *Oreodoxa acuminata*, and numerous other American species have been referred by many eminent botanists, was not established for an American palm, but for an East Indian species described by Rumphius as a *Pinanga* in 1741, and renamed *Calyptrocalyx* by Blume in 1836. Gaertner's original use of the name *Euterpe* in 1788 was however also connected with seeds of still another old-world palm not yet identified.

species, was an important step in advance of general literary chaos, though still far from logical accord with the principles of evolution and synthetic classification. From the practical standpoint also it is seriously objectionable as being but a partial measure which perpetuates and legalizes, even if in somewhat limited form, the very confusion it was desired to end.

Under the Benthamian method or 'Kew Rule' a plant might have a different specific name in each of the several genera to which different systematists might refer it, and under the so-called 'method of elimination' a generic name may be applied to several entirely different groups of species, as a result of varying theories of classification. But however inadequate for bringing about uniformity and stability of nomenclatorial practice, these propositions are of interest as admissions of the desirability of a formulated procedure instead of unguided personal caprice.

It may be charged equally against these methods, as well as against the method of types, that the authors of the older genera did not expect their writings to be interpreted by such criteria, since all three propositions have resulted from the recognition of the fact that the tasks of systematic biology are very different from the anticipations of the eighteenth century naturalists. With the prospect of a few thousand genera to be dealt with, the matter of a few synonyms for each was not important, and each naturalist might hope for the general acceptance of his improved names and descriptions. But with strengthening indications that a million genera or more will be needed to present the complexities of organic nature, sentiments of literary liberty may well give way to measures promising the practical advantages of uniformity and stability.

Moreover, where carelessness and caprice have been the rule the application of any system must be expected to result in many changes from current usage. And if the followers of the system of elimination have not hesitated to set aside many names in universal use for others discovered only by antiquarian research and supported only by individual theories of historical and literary interpretations, how much less should they object to changes made in accordance with the requirements of a method which can end, instead of merely diminishing, the instability admitted by all to be a most serious hindrance to the progress of systematic biology?*

* While this paper has been waiting for the press the type question has broken out among the spiders, a group rendered nomenclatorially difficult because many of the older generic names were proposed in connection with numerous species. Mr. F. Pickard Cambridge concludes (*Annals Mag. Nat. Hist.* (7), VIII., p. 403, Nov., 1901), after a spirited discussion with the German arachnologist, Professor Dahl, that definite types are a necessity in generic nomenclature, and that the method of elimination will not yield stability either in theory or in practice.

"Now elimination pure and simple in its practical application almost invariably lands us in an absurdity. In this way, the species which the authors withdraw are usually those that are best known, with characters salient and well described, leaving in those less well known, with this result, that the last species left in is one which is not known, is badly described, and never likely to be identified with any certainty; and this miserable phantom is left us as the type of the genus."

As a means by which this objection may be partially avoided it is proposed that when a generic name has had a specific type assigned for it the question should not be reopened, but it becomes at once apparent that the determination of the fact of such assignment would itself be a question on which differences of opinion might be entertained, so that Mr. Cambridge is brought to the further suggestion that such a designation be accepted only when the word *typ*, *typus* or *type* is used, and would rule out *exemplum*, *exemplc* and *example*, also, presumably, *original*, *original species*, *chef de file* and other linguistic and verbal differences of expression of the same idea. On the other hand, no notice is taken of the complications possible through the fact that the word type

NOMENCLATURE APART FROM CLASSIFICATION.

Another of the many sources of confusion attending literary methods of dealing with systematic writings appears in connection with the citation of authors of generic names. After the abandonment of the practice of renaming each newly adjusted concept it became customary to refer generic names, not to their original authors, but to those who had made the last or most improved emendation of the definition. With such excellent opportunities some biological highwaymen did not hesitate to appropriate for themselves the entire nomenclature of their specialties, and evidently thought that by introducing changes in the generic descriptions they would establish claims to permanent recognition. Adherence to the idea that a genus is a group of species, and not merely a concept, and that the generic name is to be attached to a species rather than to a definition, affords an effective remedy for all difficulties arising from emendations, *pro parte* references and similar complications. The generic name when firmly anchored to a type species is no longer affected by vicissitudes of opinion among systematists, and in an important practical sense the problems of nomenclature are made to stand apart from those of classification and expression.

Groups recognized as genera by some authors will not be so treated by others, but genera, however constituted, will uniformly bear the oldest name which was first applied to any of their component spe-

has been largely used, even in systematic writings, in a phylogenetic rather than in a nomenclatorial sense.

The relief afforded by this amendment is moreover very slight, as shown in a subsequent paper which undertakes the actual work of 'A Revision of the Genera of the Araneæ or Spiders with reference to their Type Species' (*ibid.*, 7, ser. IX., p. 5, Jan., 1902), and the essential instability of the process of securing types through elimination and 'implication' is recognized and frankly admitted.

"Of course an author has a perfect right to include any species he likes, and must face the consequences if the last species left in his group by subsequent withdrawals turns out to be congeneric with the type of some earlier genus, whereby he loses his name as a synonym. The process * * * leads to great confusion, for it may afterward be urged * * * that the species removed was not congeneric with the earlier genus * * * By this renewed claim * * * the equilibrium is upset all along the line, and down come a score perhaps of generic ninepins whose stability depended upon the validity of this first step. It is not possible of course to avoid this tragedy of the ninepins so well known to and so justly feared by everyone who has endeavored to fix genera upon solid ground * * * there is always the possibility that it may turn out that the two species were after all not identical, and down come several ninepins, and the whole position has to be reconsidered. We have thus to recognize and face this possibility. What we want to do however is to avoid as much as possible any steps of elimination which might court such a catastrophe."

As an example the genus *Neriene* is cited, which would become a synonym of *Linyphia* if, as some think, the last species, *N. marginata*, is congeneric with the type of that genus. Those who hold this view would however maintain that *Neriene cornuta* should serve as the type and would thus unseat the name *Dicyphus*, in which alternations 'other subsequent genera will be involved, and so on to distraction.'

That this condition is not chronic among systematists who defend the method of elimination is due to the fact that they use it with 'discretion,' as an eminent zoologist once informed me, and do not attempt any general or constant application of it to such a task as Mr. Cambridge has undertaken. Those who prefer their ninepins under the guise of nomenclature have but to hold fast to the beautifully absurd rule quoted with approval by both Messrs. Dahl and Cambridge.

"The first publication in which a genus is subdivided, whether justifiably or unjustifiably, whether in a conscious or unconscious manner, must, where no typical form was named, decide what portion of the original genus is to retain the original name."

cies, and a generic name, whenever and wherever used, will have a fixed point of attachment to nature. Progress in the science of systematic biology must still compel endless modifications of the supposed limits of genera, but the method of types affords a complete and ideal solution of all the attendant difficulties which can be correctly assigned to the province of nomenclature. By the simple expedient of treating a generic name as inseparably attached to its original species as its nomenclatorial type, the whole maze of definitions, history, casuistry, confusion and contention is resolved into definite elements capable of rational and permanent adjustment. Of two or more generic names established on the same species only the oldest should be used, no matter how much the original definitions may have differed, while genera founded on species belonging to distinct natural groups will never be the same, no matter how closely the definitions may have approximated.

HOMONYMS.

The adjustment of the claims of competing generic propositions by reference to types rather than to concepts has many practical advantages. It becomes, for example, more obvious than before that generic synonyms are of several kinds, the nomenclatorial standings of which are very different. The first recognition of such distinctions is to be found in the so-called 'law of homonyms,' to the effect that the same name should be used only once in the plant or animal series. It has been held by some systematists that a homonym or second use of the same name might hold where the first had for any reason miscarried, but the impossibility of establishing the fate of any particular name under the method of concepts and elimination has rendered it obviously unwise to risk the confusion attendant on a resurrection of the supposedly defunct older genus, and the rule or principle 'once a synonym always a synonym' is receiving general recognition. And yet this aphorism is very misleading, since all synonyms are not homonyms, and the restoration of other kinds of synonyms is a very common occurrence. 'Once a homonym always a homonym' or 'once a homonym always a synonym' would be a much more correct statement, though in these forms the idea becomes a mere truism.

TYPONYMS.

Another class of synonyms hopelessly invalid from the beginning is the typonym, a generic name based on a species which has already been used as the type of a genus. Even in dealing with a genus containing but a single species variety in definitions has often led systematists to continue the multiplication of names. Thus although Rostafinski found that the names *Strongylium fuliginoides, Dermodium inquinans* and *Lachnobolus cribrosus* had all been used for a single species of Myxomycetes, which he treated as representing a monotypic genus, he again redefined the same genus and rechristened it with a fourth name. The only possibility of resurrection for a typonym is in the event of the previous name being found to be a homonym, as in the present instance where *Strongylium* was preoccupied for a lichen, so that the correct name for the Rostafinskian genus *Amaurochætæ* appears to be *Dermodium.**

* The binomial *Dermodium atrum* (A. & S.) would have been used by Rostafinski if the principle of priority had been observed, in spite of the fact that *Dermodium* is usually treated as a synonym of the unrelated genus *Lycogala.* Neither can the name *Lachnobolus* be used in the sense in which Rostafinski and subsequent writers have employed it, since it was originally established as monotypic and included only *L. cribrosus* as above. Fries had already in 1849 applied the name *Nassula* to the species which

The present use of the word typonym, though somewhat different, does not necessarily conflict with that in which it has been employed by Dr. Gill* for names founded on types instead of on descriptions, since under the method of types, which requires that all genera be connected with species, this distinction regarding typonyms is no longer important. Although objecting to the naming of genera on types and without diagnoses Dr. Gill well says: "Certainly it is more rational to use a typonym than to require a definition for show rather than use." As a matter of fact the great majority of the older generic definitions are of little use or taxonomic value except for historical purposes, and it is a great practical advantage to be able to gain an idea of a genus from specimens, figures or detailed descriptions of a type species instead of being limited to the reconstruction of concepts based, too often, on slight knowledge and careless record. Moreover, as all systematists know, it is quite possible for many of their number to write long acounts of genera without betraying any facts of diagnostic importance, a point to receive further attention below.

Rostafinski treated under *Lachnobolus globosus* in 1875. More recently Lister has carried the confusion a step further by relegating *L. globosus* back to *Arcyria* while retaining the name *Lachnobolus* for still a third generic group represented by *L. cincinans* Fries, for which no correct generic name exists.

Lister is also in error in citing Fries, 1835 (Fl. Scand., 356), as the original reference for the genus *Lachnobolus*, which was published ten years before (Sys. Orb. Veg., 1: 148), with *L. cribrosus* as the only species. Lister's suggestion (Mon. Mycetozoa, 112) that *Lachnobolus cribrosus* Fries may have been a confluent form of *Stemonitis splendens* does not furnish a justification for the use of the generic name in a different family. The genus called *Lachnobolus* by Lister, which differs from *Arcyria* in having the sporangia sessile and the wall persistent, must be renamed, and may be called *Arcyodes*, the type being *A. incarnata* (*Licea incarnata* Albertini & Schweinitz, Consp. Fung., 109, 1805).

* *Proc. A. A. A. S.*, 45: 155, 1896.

METONYMS.

Synonyms of the third class, which may be called metonyms, differ from typonyms in not being based on the same types as the older names with which they are held to be synonymous, and unlike homonyms and typonyms, they may often be restored to active use, even after long periods of retirement. Improvement in the systematic treatment of many groups has been extremely slow, and even periods of reaction are sometimes encountered. Some biologists are as far ahead as others are behind the times, and there have been numerous instances where taxonomic work of high quality has remained unheeded for many decades, or until general progress had reached the plane where the genius of its author could be appreciated. Strangely enough, some botanists who hold to liberty of literary and historical interpretation and deprecate legislation in the interest of uniformity, have given their support to the rather barbarous proposition that systematic study which is not accepted by somebody inside of fifty years becomes outlawed. The desire to wipe away old scores of casuistry and confusion can be readily understood, but that to do this it should be thought necessary to place a premium upon reaction and ignorance has brought the ultra-literary botanists within easy range, it would seem, of an appreciation of the absurdity of their own position.

The complications for which the 'Berlin Rule' of a fifty-year limit gives partial relief are much more thoroughly obviated under the method of types, and that without discriminating against conspicuous ability and advanced ideas, and without requiring the discoverers of rare plants and animals to see that their genera are republished every half century in order to prevent the loss of copyright privileges and scientific honors to an ungracious posterity.

HYPONYMS.

A generic hyponym is a name not used because inadequately published—that is, not printed in connection with a recognized species. Again will the consistently literary botanist insist that the earlier writers studied and described their genera quite apart from species, and that it is an empirical and revolutionary proposition which would set aside tradition and usage and insist upon the arbitrary requirement of a generic type. This, however, is but an obvious corollary of the taxonomic principle that genera should not be studied and named as concepts, but as groups of species. Moreover, the regulation which it has been sought to enforce under the method of concepts, that a generic name must be accepted which was accompanied by anything whatever in the way of description, is equally arbitrary and has a fatal lack of practical utility, since most of the older descriptions are utterly inadequate for diagnosis under modern classification. That the generic descriptions had come to be recognized as a mere formality which could even be entirely dispensed with, was well shown, quite apart from the method of types, by the selection of the 'Species Plantarum' of Linnæus as the initial work of reference for botanical nomenclature. This book contains no descriptions of genera, but it was very properly held that the genera could be much more satisfactorily inferred from the species than from the descriptions given in Linnæus' 'Genera Plantarum.'

Some naturalists who have appreciated the hollowness of the idea that a mere series of words must be taken as establishing a generic name in full nomenclatorial standing, are inclined to insist that genera must really be described so as to in some measure approximate modern ideas, even though this would require the abandonment of many well-known names of the large composite genera of the older authors. However logical this procedure may be, the general application of it could only result in increased confusion, since there is not the smallest probability of agreement among naturalists as to *how much* of a description is necessary to the diagnosis of any particular genus or other natural group.

The formal requirement of a description for a species has a far more logical justification. An identifiable species locates at once one point in a genus, but subsequent students may have no clue to an uncharacterized species. It is thus a matter of expediency as well as of right to reject specific names not accompanied by descriptions, though such a practice will lead to confusion unless it be applied only to actual *nomina nuda;* far too many changes and disagreements would appear if the question of the adequacy of specific descriptions were to be raised. Practical legislation must, of necessity, converge upon technical points, and the utility of any enactment depends upon reducing the number and making plain the location of these foci. Biologically a genus is generally a group of species, but nomenclatorially it may always be narrowed to a single species, and under a binomial system to a single binomial species, which must have nomenclatorial status before it can be made the basis of a nomenclatorially valid generic name.

The limitation of taxonomic recognition to generic names established in connection with identifiable binomial species would be a most useful regulation since it would dismiss to final oblivion a large number of still-born names which for a century or more were passed over by botanists, but which the injudicious zeal of recent reformers has resurrected and attempted to galvanize to the life of modern taxonomy. The Rochester Rules were avowedly drawn to enact a law of priority under the binomial system of nomenclature, although, to give a definite point of departure, it was agreed to disregard the hundreds of binomials published before 1753. Every principle of logic and every practical consideration would have led us to expect the acceptance of the obvious corollary of that proposition—the rejection of the non-binomial literature published after that date. This simple distinction having been neglected, we have only the no longer logical but purely arbitrary 1753 rule to keep us from the older polynomial literature, to say nothing of the many pre-Linnæan books in which binomials were used. The process of restoring Adanson's names is only just begun in dealing with the botany of North America. There are pages and pages of the closely printed lists of the 'Familles' as yet not drawn upon by our antiquarian friends, but the zest with which they have delved in this débris only shows what would be their delight in first-class cemeteries like Micheli and Tournefort, if indeed they would remain content with these and not insist on pushing back to a more obscure antiquity. Seriously, however, the reinstatement of these Adansonian and similarly unattached and long-forgotten names is an utterly needless imposition contrary to the spirit in which the reform attempted at Rochester and Springfield was encouraged and supported by the botanical public.

CACONYMS.

This necessity of some provision for the more definite limitation of taxonomic literature on the sides of Latinity, brevity and binomiality can be made even more obvious by reference to a neglected contribution to the botany of Mexico, the work of Francisco Hernandez: 'De Historia Plantarum Novæ Hispaniæ.' This was published in Madrid in 1790 from manuscripts written in the sixteenth century. It records names for toward a thousand genera of Mexican plants and antedates a large part of the current systematic botany of that and the neighboring regions. The three quarto volumes contain a total of 1,611 pages, and are written in Latin throughout, with the adoption of the Aztec names which stand either alone or in the form of binomials. Thus the first chapter is headed: 'De Apitzalpatli crenata, seu de herba secta per ambitum fluxum alvi cohibente.' Then follow 'Apitzalpatli altera, Apitzalpatli Uyauhtepecensi, Apitzalpatli Tehoitztlac, Apitzalpatli Teuhaltzincensi,' and others equally unmanageable by the tongues of European peoples, though differing only in degree from Thlaspi, Gajati, Alhagi, Tsubaki, Tsjinkin, Hombak, Sinapi, Gansblum, Konig, Korosvel, Canschi, Malagu, Coddampulli, Mangostan, Japarandi, Celeri, Chocho, Mokos, Agialid, Tsususi, and hundreds of others which have not prevented the recent resurrection of the taxonomy of Adanson's 'Familles,' in spite of the fact that it had been almost universally ignored for upward of a century. An objection might be taken to the specific names of Hernandez because his work is not consistently bionomial, but the fact that he so frequently uses names of that form would seem to give his generic designations a better claim to recognition than those of the strictly monomial Adanson, or those of the numerous polynomial post-Linnæan writers like Haller. But however effective such reasoning might be if Apitzalpatli stood alone or with a few similar terms, the fiercest Adansonians may well quail before what Hernandez was able to transcribe after he had acquired more fluency in Aztec: Tlalaxixquilitl, Tlaltecomaxochitl, Tlalacxouatl, Atonahuizpatli, Tlatlauhquichicomacatl, Yztacchacomacatl, Copalquahuitlpatlahoac, Tlahoelilocaquahuitl, Tzinacancuitlaquahuitl, Yztacpatlichichipiltic and Chichictlapalezquahuitl. Even Hernandez seems to have had a suspicion that some of these names were too long to meet with general popularity outside of Mexico, for in several instances he suggested more manageable abbreviations. Thus chapters are not infrequently headed like the following: 'De Chichictzompotonic, seu Tzompotonic amara'; 'De Cozticcoanenepilli, seu Coanenepilli lutea'; 'De Yztacquahxiotl, seu Quauhxiotl alba'; 'De Tecopalquahuitl, seu Copalli montana.'

But the second generic names, though shorter, are no more Latin than the first, and the practice of determining priority by position would prevent their being taken up in preference to the preceding unmodified designations.

From the standpoint of some taxonomists the forms of names appear of merely incidental importance, and the tendency of recent years has been toward the acceptance of the oldest designation, no matter how inappropriate, incorrect, barbarous or foolishly long it might be. Hybrids formed by the compounding of Greek with Latin roots, though a frequent cause of protest from biologists of classical training and sensibility, are really among the lesser difficulties, and a partial defense of them is to be found in the fact that, although the language of systematic biology is Latin, it has continued and extended the custom of the Romans in drawing freely from the richer and more convenient Greek vocabulary available for the formation of scientific terms. But there are practical as well as merely literary difficulties in connection with unreasonable names, and while some of these can be excluded on other grounds than those of form there will remain a not unimportant residue of the results of past, present and doubtless future ignorance and lawlessness, which it seems unnecessary to inflict as a permanent legacy to scientific posterity.

Whether in using hybrid and barbarous names we are following in the lines which Latin literature would have taken is, after all, of relatively little importance. Convenient names which can be understood readily and remembered easily are the object of our quest. Names like *Sebastianoschaueria* and *Reichembachanthus* may be etymologically correct, but they are certainly not convenient, and the same may be said of many impersonal compounds of ungainly length, such as *Archispirostreptus*, *Necrophlœophagus* and *Synthiloborhamphus*. Apparently to avoid the labor of finding an unused short name, some systematists seek safety in huge polysyllables which they feel sure that none of their predecessors can have had the hardihood to perpetrate. But that these absurd creations are strung out in accordance with the rules of Greek grammar is scarcely a sufficient reason why systematic biologists must remain at the mercy of nomenclatorial indolence and folly. The man who named his daughter Encyclopedia Britannica was rewarded for his pains by hearing the neighbors call her 'Tan,' and similar abbreviations are in many instances in order among scientific names.

To avoid the numerous complications and uncertainties attending the subject of caconyms it has been suggested that names be treated as arbitrary symbols outside language and literature, to be preserved in their original forms, typographic errors and all. For such the names of Adanson and Hernandez are but opportunities for the display of zeal in the cause of priority. Indeed, one phonetic outrage at a time is evidently not enough for those who think to serve science by compelling us to say such things as *Symphoricarpus symphoricarpus, Taraxacum taraxacum, Hypopitis hypopitis, Opuntia opuntia, Zizyphus zizyphus, Cracca cracca, Sassafras sassafras, Benzoin benzoin* and other gibberish first advocated by the ornithologists who evidently proceeded on the analogy of *Coo coo, Caw caw, Quack quack* and other sounds familiar to them, and did not foresee the certain fate of the tropical planter who should find as the result of his botanical studies that his garden contained *Cajan cajan, Manihot manihot, Malvaviscus malvaviscus, Jambosa jambos, Ananas ananas, Karatas karatas, Guazuma guazuma, Lebbek lebbek* and *Lablab lablab,* to say nothing of the horrors he might encounter in the forest. And all this because Dr. Linnæus refused to accept numerous genera named by his predecessors, but used their generic names of species!

Those who believe that this historical complication compels the permanent use of duplicate binomials should begin practice with Chichictlapalezquahuitl, since the Juggernaut sect of devotees to priority has not hesitated to resurrect and even to make duplicates of equally barbarous, if less extensive, names from books much less scientific than Hernandez. If, as claimed by Mr. Pollard,* there is no middle ground between the correction of orthographic and typographic errors and the acceptance of all mistakes and barbarisms, a continuation of the present nomenclatorial tendencies will but prepare a welcome for the reformers who shall extend and complete the work of Professor Greene in the extirpation of incorrect, inconvenient and barbarous names, and the substitution of others justified by classical reference and usage; not primarily because such terms are Latin, nor because they are classical, but because it will have become apparent that adherence to a reasonably limited, never-changing vocabulary is the only safe basis for legislation in the interest of a convenient and stable nomenclature.

* Science, N. S., XIV., p. 280, Aug. 23, 1901.

The hope that stability might be secured by the acceptance of incorrect, inconvenient, barbarous and nonsensical names is obviously vain, and it is rapidly becoming apparent that such concessions to ignorance, recklessness and freakishness carry with them more serious dangers than they avoid.* We could afford to have many differences of opinion and usage in the names of plants rather than accept taxonomic contributions like those of Hernandez and Adanson, and a stability which would bind us to such idols would be a doubtful blessing.

But notwithstanding its annoying complexity, the subject of caconyms has the redeeming feature that it can be treated quite apart from all other aspects of nomenclatorial reform, and as it is the side which touches nearest upon the field of general literature and individual opinion and taste, it is here that reliance upon usage or an agreement to disagree would be a benefit to systematic biology if it made possible the much-needed unanimity on the

* The somewhat pharisaical complacency with which some of my zoological friends were inclined to view the Hernandez complication as a purely botanical difficulty is no longer appropriate in view of the recent delivery by a South American zoologist of a large brood of nomenclatorial monsters which, since they have come in the twentieth century, instead of in the sixteenth, show even more strikingly than those of Hernandez the necessity of nomenclatorial discrimination. Two protests have already appeared (*Osprey*, V., p. 142, Sept., 1901, by Professor Gill, and Science, N. S., XIV., p. 693, Nov. 1, 1901, by 'F. A. B.') but the authors of names like *Guilielmoscottia, Oldfieldthomasia, Edvardotrouessartia* and *Asmithwoodwardia*, are, of course, impervious to reason or to ridicule, and will be effectually deterred only by the refusal of systematists to recognize their multipedalian progeny as a legitimate part of biological taxonomy.

weightier principles and methods of taxonomic procedure. General legislation, to cover all normal instances, must be axiomatically rational, definite and simple if it is to be universally understood and approved, but there could be no serious objection to the reference of this semi-literary department of nomenclature to a permanent committee or academy, just as it has been found advantageous to have a board of specialists for officially determining the forms of geographic names. And it should also not be forgotten that if no direct provision for dealing with caconyms should prove possible, a large measure of relief from Adanson, Hernandez and other nomenclatorial incubi could still be obtained through closer adherence to the binomial requirement for genera as well as for species.

ESSENTIALS OF BIOLOGICAL NOMENCLATURE.

In the way of summary of the present and former discussions of the method of types* it may be repeated that the long-wished-for uniformity and stability could be secured by consistent adherence to a few simple and well-nigh axiomatic principles.

1. The primary object of formal nomenclature in systematic biology is to secure convenience, uniformity, and stability in the names of plants and animals.

2. Biological nomenclature should be treated as beginning with the general use of binomial Latin names for plants and animals.

3. A name must be used for the natural group to which it was first applied.

Moreover, if we begin from the practical end of the problem instead of viewing it merely from the literary standpoint, the formulation and application of these principles encounters far less serious complications than have attended the unstable method of elimination.

DESIGNATION OF TYPES.

1. The nomenclatorial type of a species is the specimen originally studied, named and described by the author of the specific name.

2. The type of a genus is the first species referred to it, and the generic name can be used only for species treated as congeneric with the type.

(*a*) The author may designate, however, some other species as type in the same paper in which the name is published.

(*b*) For a generic name adopted from a pre-Linnæan or a prebinomial writer the type species is selected without reference to the binomial system of nomenclature, but works older than Tournefort's 'Institutiones' (1700) should not be cited in botany.

CLASSIFICATION OF SYNONYMS.

Under the method of types names are rejected or treated as synonyms in biological taxonomy for the following reasons:

1. When preoccupied (homonyms).

(*a*) A generic name is preoccupied when it has been previously proposed for a different group of the same (plant or animal) series.

(*b*) A specific or subspecific name is preoccupied when it has been applied to a species or subspecies under the same generic name.

2. When there is an older valid name based on the same type (typonym).

3. When there is an older valid name based on another member of the same group (metonym).

4. When the natural group to which the name applies is undetermined (hyponym).

(*a*) A specific name is a hyponym when it has not been connected with a description identifiable by diagnostic characters or by reference to a type specimen, figure or locality.

(*b*) A generic name is a hyponym when it has not been associated with an identifiable binomial species.

5. When the form or signification of the name is inconvenient, incorrect or inappropriate (caconym), should a recognized method of dealing with these complications be formulated.

O. F. Cook.

Washington, D. C.,
February 10, 1902.

* *Bulletin of the Torrey Botanical Club*, 22: 431–434, October, 1895; Science, N. S., 8: 186–190, August 12, 1898; Science, N. S., 8: 513–516, October 14, 1898; *American Naturalist*, 33: 287–297, April, 1899; Science, N. S., 12: 475–481, September 28, 1900; Science, N. S., 13: 712–713, May 3, 1901.

SPRING MEETING OF THE COUNCIL OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE Council of the American Association for the Advancement of Science met on April 17 in the Assembly Hall of the Cosmos Club at Washington. President Minot occupied the chair and President-elect Asaph Hall was in attendance as were also Messrs. Benjamin, Cattell, Clarke, Fewkes, Galloway, Gilbert, Gill, Howard, Hyde, Lee, McGee, Morley, Nichols, Pearson, Peters, Stiles, von Schrenk, Welch, Woodward and Wright.

The Permanent Secretary presented a report upon the operations of his office since the midwinter meeting of the Council held at Chicago, Ill., January 1. The delay in the publication of the Denver volume was explained in part by the delay in the receipt of certain manuscripts from Secretaries of Sections and in part by the new conditions which govern the administration of the firm of printers which has handled the volume the past two years. The volume is now entirely in type and will probably be ready for distribution in a week or so. A list of the new members elected by the subcommittee of the Council empowered to act promptly on applications was presented and the statement was made that in past fifteen months 1,566 persons have been elected, of whom 1,406 have completed membership.

Arrangements for the Pittsburg meeting are progressing favorably. The Permanent Secretary visited Pittsburg on March 22, and met about fifty members of the Local Committee, selected the rooms for the meetings of the different sections and the affiliated societies, ascertained that a substantial fund had been subscribed, and that the people of Pittsburg are interested in the meeting and are looking forward to it with pleasure. It was also announced that preliminary arrangements are already being made for the probable Washington meeting during Convocation Week, beginning December 28, 1902. The Columbian University and Georgetown University have promised the use of all of their University buildings for meeting rooms.

The financial report of the Permanent Secretary for the calendar year 1901 was presented and was approved by the Council and ordered placed before the Association at the Pittsburg meeting. The report shows receipts during the year of $21,-373.59, and a balance on hand December 31, 1901, of $12,285.83, after transferring to the Treasurer the sum of $2,050.00

The committee appointed at the midwinter meeting with power to act upon the application of the Bibliographical Society of Chicago with regard to a bibliographic exhibit at the Louisiana Purchase Exposition, reported, through Mr. Cattell, that the committee had notified the Society that the Association regards it as desirable for the Exposition to secure the advice of expert bibliographers in the compilation of its publications and to arrange if possible for an international bibliographical exhibit.

The Committee on Convocation Week reported, through its chairman, Dr. Minot, that since the last report agreements to 'Convocation Week' arrangements have been received from a number of universities and colleges, including the University of Illinois, Lehigh, Cincinnati, Indiana, Van Rensselaer, Dartmouth, Iowa, Brown, Smith, McGill, Lafayette, Ohio, Pennsylvania, Wisconsin, Nebraska, Toronto, Georgetown, making a total of 54 in all, only two of which are outside of the United States.

An intimation having been received by the Council that the American Philological Association, the Archæological Institute of America and the American Philosophical Association might welcome an invitation from the Association to affiliate with the

Association it was moved and carried that an invitation be extended to these organizations.

Dr. Minot reported from the subcommittee upon the affiliation of certain of the medical societies that the invitation to affiliate was sent out to several societies, but that sufficient time had not elapsed to allow these societies to take action.

Dr. Lee reported that the Council of the American Physiological Society had resolved to report favorably upon the proposition of the Association as a whole, but that action by the Society cannot be taken until its next meeting.

An appropriation of $25 or so much thereof as may prove necessary was made for the purpose of sharing in the expense attending the reception of Lord Kelvin to be held by several national scientific organizations in New York City on April 21.

A letter was read from the Librarian of the Manchester (N. H.) Institute of Arts and Sciences, stating that their library had been destroyed by fire last January, and, on motion, the Permanent Secretary was directed to present to the Institute as full a set of the Proceedings of the Association as should prove practicable.

A letter from Dr. Franz Boas relating to a proposed 'Association of American Anthropologists' was read, in which he asked the opinion of the Council of the Association concerning the possibility of a practical substitution of this national society for Section H of the American Association, all members of the new society becoming members of the American Association, the society to have the privilege of levying additional assessments of its own. Some discussions ensued and a motion by Mr. Gilbert was finally adopted to establish a committee on the relations of the A. A. A. S. to other scientific organizations and that the proposition from Dr. Boas be referred to this committee. It was further moved and carried that the President of the Association be made a member of the committee.

The following resolution was read by Mr. Cattell:

Resolved, That the Permanent Secretary be authorized to collect the dues of members of societies affiliated with the Association if requested to do so by any of those societies.

Dr. Stiles moved that the Committee on Convocation Week be requested to take into consideration the advisibility of addressing officials in charge of Government scientific bureaus in an effort to secure action which will result in the detail of scientific men in the employment of the Government to attend scientific meetings held during Convocation Week without prejudice to their annual leaves of absence, thus accomplishing for this class of workers what the committee has been able to secure through the different universities for the teachers in the higher educational institutions.

The Secretary-elect of Section I, Professor W. F. Wilcox, having resigned through press of work, on motion of Mr. Hyde, Frank R. Rutter, of Washington, D. C., was elected Secretary of Section I.

SCIENTIFIC BOOKS.

THE DUTCH EXPEDITION TO THE MALAY ARCHIPELAGO.

Siboga-Expeditie, Introduction et Description de l'Expédition. Par Max Weber, Monographie I.

This is the first of a series of sixty-five monographs which are to appear from time to time as the results of the cruise of the *Siboga* through the Malay Archipelago. One need hardly add that such a series, under the authorship of many of the best known continental specialists, will prove an important complement, if not a rival, to the reports of the *Challenger.*

The introductory monograph by Professor Max Weber, director of the expedition, gives a clear outline of the proposed work, a historical summary of the researches relating to this region and a condensed journal of the cruise during its year of collecting.

Great interest in the biology of their East Indies has always been shown by the Dutch, and the rich tropical fauna and flora of this region have already been examined at first hand, although in but a preliminary way, by many of their best observers. The present expedition can, therefore, be looked upon as the logical outcome of a cumulative interest. Not long since a society was formed for the 'Encouragement of Explorations in the Colonial Possessions of the Netherlands,' and it was at the instance of this society, through the efforts of Professor Hubrecht, of Utrecht, and other leading zoologists, that the Dutch government lent its aid to the undertaking. This materialized in the loan of an admirably equipped war vessel, the *Siboga,* for the purpose of a general exploration of the marine fauna of the Dutch East Indies. Among zoologists generally, it is well known that the *Siboga* started on its cruise under exceptionally favorable auspices; no vessel was better equipped for zoological collecting, and its naval personnel, from Captain Tydeman down, was selected with extreme care—the latter feature almost as important to the staff of naturalists as the former. The vessel started on its cruise in March, 1899, returning to Java without mishap just a year later. Over three hundred dredging stations were recorded at points well scattered throughout the archipelago. The itinerary was a long one; the vessel passed first along the southern row of islands as far as Timor, thence northerly through the Strait of Makassar, as far as the Sulu group in the Philippines; thence back to Celebes, then again northerly to the neighborhood of the Philippine Island, Mindanao; thence southerly through the Molucca passage, and among the islands of the sea of Ceram, as far as the coast of New Guinea; thence through the sea of Banda, and among the southern group, Timor, Flores, Lombok, back to Java. The present monograph gives, although in a concise form, an idea of the fauna of the little-studied deep and shallow waters of the archipelago, and of the wealth of material which now has been distributed among the specialists who are to report upon the collections. Hardly of less interest are the extensive researches undertaken by Captain Tydeman and the party in the hydrography of this region.

It is a difficult task for the reviewer to select the most important of the points brought out in the first monograph. One may pick out at random these: There is evidence that the famous 'Wallace's line' between Borneo and Celebes, is far less distinct than formerly believed, and indeed of minor importance in the matter of the distribution of marine forms; in this regard we note that the narrow strait between Bali and Lombok through which this line passes is much shallower than heretofore believed, practically within the one hundred fathom mark.

Important too is the discovery of actual barriers separating the deep waters, or seas of the archipelago from the neighboring oceans, barriers which had long been conjectured to account for the fact that the deep waters of the archipelago, *i. e.,* those greater than 1,600 meters, are of uniform temperature (about 3 degrees C.), while those of adjacent oceans become colder as the depth increases. The present memoir contains many interesting biological notes. We may cite, as examples, the reference to the Palolo worm, whose extraordinarily regular and sudden mode of occurrence has so long puzzled zoologists; the method of sailing by the sword fish, *Histiophorus;* the relations of *Lithothamnion* colonies; curious aboriginal methods of fishing; notes on shallow water phosphorescent fishes; measurement (in candle power) of the flashes of the phosphorescent fish, *Photoblepharon;* living conditions of glass sponges; notes on *Coccosphæra,* much discussed of deep-sea expeditions—these are shown to be plants, their chromatophores and division having been studied in living material by Mme. Weber.

Among geological notes we find that Mesozoic deposits, hitherto known only in and near

Java, are continued throughout a number of the easterly islands: also that in deep water and distant from shore, land remains such as fruit and leaves of palms are found in dredgings, confirming from this region the observations of Alexander Agassiz on the *Blake*.

BASHFORD DEAN.

Die Reizleitung und reizleitenden Strukturen bei den Pflanzen. By B. NĚMEC. Jena, G. Fisher. 1901. Pp. 153; pl. 2. Price, Mk. 7.

Nowadays it is to be expected that any theory developed in connection with the phenomena of animal life will quickly be applied to investigation in the action of plants and *vice versa.* Witness the well-known exploitation of heliotropic phenomena in animals after their elaboration in plants. Since the discovery of the fibrillar structure in the nervous system of animals and the development of the neuron theory have shed so much light upon the propagation of impulses in animals, it was to be expected that similar investigations should be made upon plants. This has been done by Němec and the results are embodied in a book of considerable size.

Though he gave some attention to geotropic and other stimuli, Němec studied chiefly the propagation of the stimulus caused by wounding, because this manifests itself by a notable disturbance in the structure of the cell. The protoplasm of cells adjacent to the wound aggregates upon the side of the cell next to it, whither also the nucleus migrates. This disturbance spreads in all directions at a definite rate (in the root of onion about 1.25 mm. lengthwise in the first fifteen minutes), and recovery follows shortly. The propagation is most rapid in the longitudinal axis. Němec sought a structural basis for this difference and believes that he has found it in protoplasmic strands or fibrils, which are readily demonstrable in certain cells, particularly those of the plerome. These strands run lengthwise from one end of the cell to the other and are resolvable, with proper staining and magnification, into fibrils, each of which is surrounded by a distinct sheath. In the center of the cell the strands are often large and distinct, but near the ends they spread out into a brush of fibrils, which reach the wall but do not penetrate it. According to Němec, propagation of the impulse takes place along these fibrils, becoming general and diffuse in the protoplasm at the ends of the cells, and passing from one cell to another by way of the minute general protoplasmic connections, which by analogy he assumes to exist, though he does not demonstrate them. Němec lays much stress upon the fact that in adjacent cells the fibrils correspond on opposite faces of the wall, though the significance of this point is not clear in view of the lack of demonstrable connection through the wall. Such fibrillar structures were found in several monocotyles, dicotyles and some ferns. Inasmuch as operations for the removal of the fibrils alone were impossible, Němec caused their degeneration by sudden changes of temperature, finding afterwards the rate of propagation retarded. In roots of *Vicia Faba,* where fibrils are found only in the plerome, the severance of the plerome inhibited geotropic curvature entirely or at least above the cut, the inference being that it did so by interruption of the fibrils.

The work of Němec is certainly a careful and thorough piece of research, which will doubtless stimulate further inquiry along this line. It is not convincing, however, in its present stage. The author himself admits that impulses are transmitted by cells in which there are no fibrils, holding only that when present they facilitate propagation. If this be true they should be best developed in those organs whose reactions are quickest. Yet Haberlandt—who has already interested himself in the problem—has been unable to discover them in the vicinity of the sensitive hairs of *Aldrovandia,* the stamens of *Opuntia,* or the tendrils of *Cucurbita.* Further, it should be noted that the cell rows in which the fibrils are best developed—often those which become tracheæ—are not only an unlikely line of transmission but that no actual protoplasmic connection in them has been shown. Finally, the experiments showing retardation following interruption or disorganization of the fibrils are inconclusive because the same conditions might inhibit the action of the real lines of propagation, whatever they are.

Further investigation is demanded for the elucidation of this interesting problem.

C. R. BARNES.

THE UNIVERSITY OF CHICAGO.

Roscoe-Schorlemmer's Ausführliches Lehrbuch der Chemie. Von JUL. WILH. BRÜHL, Professor an der Universität Heidelberg. Neunter Band, *Die Kohlenwasserstoffe und ihre Derivate oder organische Chemie;* Siebenter Theil. Bearbeitet in gemeinschaft mit EDWARD HJELT und OSSIAN ASCHAN, Professoren an der Universität Helsingfors, O. COHNHEIM, O. EMMERLING und E. VAHLEN, Privatdocenten an der Universitäten Heidelberg, Berlin und Halle, A. S. Braunschweig, Druck und Verlag von Friedrich Viewig und Sohn. 1901.

The present volume, being the seventh volume of 'Organic Chemistry,' and the ninth volume of Roscoe-Schorlemmer's 'Ausführliches Lehrbuch der Chemie,' constitutes the closing volume of this important work. It deals with three distinct topics of physiological chemistry, viz., the 'Chemistry of the Albuminous Bodies and the Constituents of Bile,' written by Dr. O. Cohnheim, of Heidelberg; 'Enzymes,' written by Dr. O. Emmerling, of Charlottenburg; 'Ptomaines and Toxines,' written by Dr. E. Vahlen, of Halle.

The section on proteids covers 331 pages, and is a well-presented statement of facts and theories bearing on the various classes of proteids of physiological interest. It is thoroughly up-to-date, and makes a valuable addition to the list of handbooks which aim to present a systematic account of the chemical nature of this important group of proximate principles.

The section on 'Enzymes' is divided into eight chapters, dealing respectively with enzymes which have a splitting action on monosaccharides, disaccharides, polysaccharides, glucosides, glycerides, etc., while other chapters or subsections deal with oxidizing and reducing enzymes, clotting enzymes, proteolytic enzymes of both animal and vegetable origin, amide-splitting enzymes, etc.

The last section of the book, by Dr. Vahlen, deals with ptomaines and toxines, and constitutes an interesting chapter on the chemistry of these products of bacterial life and growth.

The volume, as a whole, reflects great credit upon the several authors, and will undoubtedly prove of great service as a reference handbook for physiological chemists.

R. H. CHITTENDEN.

History of Geology and Paleontology to the End of the Nineteenth Century. By KARL ALFRED VON ZITTEL. Walter Scott. 1901. 16mo. Pp. xiii + 562.

This work is timely. Lyell's synopsis of views and opinions comes down to barely seventy-five years ago; Whewell's chapters on geology, though nominally covering the period down to 1855, are unsatisfactory at best; d'Archiac's work, too voluminous for the ordinary student, ends with 1859; while nearly all of the other so-called histories are histories, not of the science as a whole, but of separate branches surrounded by a framework of chapters upon other branches. The preparation of a history of geology and paleontology is no longer a simple task, and before many years it will be an almost impossible task, for the several lines of investigation now embraced under the general title of geology are fast becoming wholly independent sciences. One must welcome this history, covering the whole period to the end of the nineteenth century, prepared by one who first attained eminence in geology and afterwards turned with equal success to paleontology.

The introduction of 153 pages reviews the steps by which the science advanced. The synopsis of opinions held by ancient writers is just, with full recognition of their merits, yet showing their defects in such manner that no excuse remains for regarding the Greek philosophers as gifted beyond modern students. One hundred pages are devoted to the 'heroic age,' 1790 to 1820, in which one finds appreciative discussions of the doctrines presented by Werner, Hutton, Playfair, Humboldt, Kant and the rest, which, too often, have received either unstinted praise or unstinted censure.

The story since 1820 is told briefly, as that is given in detail beyond.

The main portion of the work contains chapters on cosmical, physiographical, dynamical and stratigraphical geology, petrography and paleontology, which are not mere narratives, not mere synopses of individual contributions: they are true histories; the opinions of investigators are given, their value discussed and their bearing upon the advancement of the science determined. The reader may detect here and there evidence of positive bias, or he may feel that the decision is inexact, but in every instance he must recognize the author's effort to maintain a judicial attitude—and it may be said that the effort has been so far successful as to place the work in a class by itself.

The statement has been made frequently that Germans are inclined to ignore the work of English-speaking peoples, but there is no trace of any such inclination in this work. Professor Zittel has been a faithful student of British and American contributions, and the references to such titles compare in number very favorably with those to works in German or French. This history will prove more than serviceable to the geologist who finds the daily accumulation of literature bearing upon his own immediate line of work so burdensome as to prevent him from keeping track of advance along other lines.

Mrs. Ogilvie-Gordon, the translator, has done her work well, for hardly a trace of German idioms remains. The text is enriched with brief biographical notices of deceased geologists and with thirteen portraits. The index of authors is complete and in a measure replaces the bibliography, which the British publisher felt compelled to omit. The index of subjects is less satisfactory, being much too brief.

John J. Stevenson.

SCIENTIFIC JOURNALS AND ARTICLES.

The April number (Vol. III., No 2) of the *Transactions of the American Mathematical Society* contains the following papers: 'On the Small Divisors in the Lunar Theory,' by E. W. Brown; 'On the Holomorphisms of a Group,' by J. W. Young; 'A Simple Non-Desarguesian Plane Geometry,' by F. R. Moulton; 'On the Real Solutions of Two Linear Homogeneous Differential Equations of the First Order,' by M. Bôcher; 'On a Recent Method for Dealing with the Intersections of Plane Curves,' by C. A. Scott; 'A Complete Set of Postulates for the Theory of Absolute Continuous Magnitude,' by E. V. Huntington; 'Complete Sets of Postulates for the Theories of Positive Integral and of Positive Rational Numbers,' by E. V. Huntington.

The April number (Vol. VIII., No. 7) of the *Bulletin of the American Mathematical Society* contains the following articles: 'The February Meeting of the American Mathematical Society,' by E. Kasner; 'Note on the Transformation of a Group into its Canonical Form,' by S. E. Slocum; 'Some Applications of Green's Theorem in One Dimension,' by O. Dunkel; 'On the Forms of Quintic Scrolls,' by V. Snyder; 'Simplified Definition of a Group,' by E. V. Huntington; 'Note on Isotropic Congruences,' by L. P. Eisenhart; 'Kronecker's Lectures on the Theory of Numbers,' by G. A. Miller; 'Notes' and 'New Publications.'

The *Botanical Gazette* for March contains the following: Professor Frederick C. Newcombe, of the University of Michigan, publishes the first instalment of a paper upon the 'Geotropism of Roots,' the result of a number of years of investigation. His results will be noted upon the completion of the paper. Miss Alice Eastwood, of the California Academy of Sciences, continues her descriptions of an interesting collection of plants from Nome City, Alaska, describing several new species and completing descriptions of many species already poorly known. John Gallatin Hall has published some interesting results of an embryological study of *Limnocharis emarginata*, a South American member of the Alismaceæ. Some of the interesting features are as follows: The tapetal cell of the ovule is cut off, but no division wall is formed, the cell disappearing early; the antipodal cell following the first division of the megaspore nucleus remains undivided, so that there is no antipodal group or lower polar nucleus; the upper polar nucleus migrates to the antipodal end of the sac and there divides, one daughter-cell remaining in that position and becoming cut off by a wall across the sac, the other moving back to the egg and eventually forming a considerable mass of endosperm; fertilization takes place very soon after pollination, material killed within eighteen hours after pollination showing the embryo in a two-celled stage; in addition to the ordinary development of a single embryo, polyembryony may occur, as in *Erythronium* and *Tulipa,* by the division of the suspensor cell to form an extensive embryogenic mass of tissue. C. L. Shear, of the Department of Agriculture, discusses generic nomenclature, bringing up the difficulties connected with determining generic names among certain fungi. He does not offer a set of rules, but reaches the conviction that the so-called 'type-method' is both desirable and practicable. He urges the importance of selecting a starting point for genera, definite provision being made for the treatment of genera having no binomial species referred to them at the time of their original description. W. W. Ashe, of Raleigh, North Carolina, describes new species of *Fraxinus, Tilia* and *Cratægus;* while Newton B. Pierce, of the Department of Agriculture, describes as a new species (*Alternaria citri*) the fungus disease of navel oranges that has attracted attention in California for the past eight or ten years, and which is popularly known as 'black rot of oranges.'

IN *Popular Astronomy* for April, Percival Lowell, of Boston, gives an 'Explanation of the Supposed Signals from Mars of December 7 and 8, 1900.' Many will recall that it was then reported that Mars had been signaling the earth; that lights had suddenly shone out brightly, and then vanished. The explanation is that this misrepresentation came from a telegram sent to Mr. Lowell as to a projection then observed on the surface of Mars, similar to those more often seen on the moon. From a study of the projections on Mars, the writer believes that these are due to clouds floating in the air rather than to mountains on the surface.

George C. Comstock writes of the 'Motion of Comets when far from the Sun.' He speaks of comets as they are commonly considered, as mere visitors who come from the region of the fixed stars, and after a temporary sojourn here return. An interesting popular article on the 'Zodiacal Light' is written by Arthur K. Bartlett, of Battle Creek. This light which is seen at this time in the year on any clear moonless night after sunset might be mistaken for the aurora borealis by those unacquainted with astronomy, were it not for its position and form. Its form is that of a cone or pyramid having its top rounded, and its base directed toward the sun, and with a light like that of the Milky Way. Mr. Bartlett speaks of the various theories to which this illumination has been, and is, attributed, inclining towards the one most generally accepted, though not established, viz., that of meteors combining in unknown millions, reflecting to our eyes the peculiar light in question, borrowed from the sun, around which they revolve probably as do the planets. The usual amount of space is given to current news and notes of comets, asteroids, planets and variable stars, and to various short articles.

SOCIETIES AND ACADEMIES.

NATIONAL ACADEMY OF SCIENCES.

THE annual stated session of the Academy was held in Washington, D. C., April 15 to 17, inclusive.

President Alexander Agassiz presided at the meetings, which were attended by the following members: Messrs. Abbe, Abbot, Agassiz, Allen, Becker, Billings, Boas, Boss, Brewer, Brooks, Cattell, C. F. Chandler, S. C. Chandler, Chittenden, C. B. Comstock, Crafts, Dall, Emmons, Farlow, Gilbert, Gill, Hague, Hall, G. W. Hill, Langley, Minot, S. W. Mitchell, Moore, Morley, Newcomb, Nichols, Osborn. Peirce, Penfield, Pickering, Prudden, Remsen, Richards, Sellers, E. F. Smith, Walcott, Welch, White, and Woodward.

Most of the time during the sessions was devoted to routine business, hearing reports from the officers of the Academy, chairmen of standing committees, trust funds, etc., and reading scientific papers.

Mr. Samuel F. Emmons, of Washington, D. C., was elected treasurer of the Academy in place of Mr. C. D. Walcott, resigned.

The following gentlemen were elected members of the Academy: William W. Campbell, Director of Lick Observatory, Mount Hamilton, California; George E. Hale, Director of Yerkes Observatory, Williams Bay, Wisconsin; C. Hart Merriam, Chief of the Division of Biological Survey, U. S. Department of Agriculture, Washington, D. C.; William Trelease, Director of the Missouri Botanical Garden, St. Louis; Charles R. Van Hise, Professor of Geology, University of Wisconsin, Madison.

The Academy will next meet in Baltimore on November 11.

The scientific program was as follows:

'Evolution of the Titanotheres, III.,' Models and Restorations: Henry F. Osborn.

'Homoplasy and Latent Homology; A Correction': Henry F. Osborn.

'Evidence that North America and Eurasia Constituted a Single Zoological Realm during the Mesozoic and Cenozoic, and that Correlations can be Established as a Basis for Uniformity of Geological Nomenclature': Henry F. Osborn.

'Monograph of the Bombycine Moths of America, including their Transformation; with a Revision of the Known Genera, Part III., Sphingicampidæ': Alpheus S. Packard.

'On the Coral Reefs of the Maldives': Alexander Agassiz.

'On the Theory of the Formation of Coral Reefs': Alexander Agassiz.

'Psychophysical Fatigue': J. McK. Cattell.

'On Some Optical Properties of Asphalt': Edward L. Nichols.

'The Classification of the Sciences': Charles Peirce.

'The Postulates of Geometry': Charles S. S. Peirce.

'The Color System': Charles S. Peirce.

'The Compulsory Introduction of the French Metrical System into the United States': William Sellers.

'The Disintegration of Comets': Asaph Hall.

'A New Computation of the Coefficients of Precession and Nutation': : Ira Ibsen Sterner. Introduced by Asaph Hall.

'The Distribution of the Stars': E. C. Pickering.

'The Variability in Light of Eros': E. C. Pickering.

'The Physiological Station on Monte Rosa': H. P. Bowditch. (With lantern illustrations.)

'On Catalysis': James M. Crafts.

'The Atomic Weight of Cæsium': T. W. Richards.

'The Significance of Changing Atomic Volume': T. W. Richards.

'Determination of the Weight of the Vapor of Mercury at Temperature Below 100°': Edward W. Morley.

'Biography of Professor William A. Rogers': Arthur Searle. Presented by Edward W. Morley.

'Biographical Memoir of General J. G. Barnard': Henry L. Abbot.

'Biographical Memoir of General Francis A. Walker': John S. Billings.

'Biographical Memoir of J. S. Newberry': C. A. White.

'The Present Aspect of Our Knowledge as to the Constant of Aberration': S. C. Chandler.

THE GEOLOGICAL SOCIETY OF WASHINGTON.

At the meeting of the Society on March 26 the first paper, by Mr. M. L. Fuller, was entitled 'The Catskill Rocks in Northern Pennsylvania.' The term Catskill was used by the speaker to indicate the great series of shales and sandstones, predominantly red in color, which constitute the upper portion of the Devonian sediments in Pennsylvania and New York. The progressive rise of the plane of the lowest red beds to the westward was shown by sections. In the Catskill mountains the lower red beds rest upon the Hamilton, while in Columbia County, Pennsylvania, they appear only after some 1,850 feet of Ithaca and 450 feet of Chemung beds had been deposited. Again, near Tioga, Pennsylvania, 1,500 to 2,000 feet or more of Chemung rocks are exposed beneath the red beds without the bottom being shown, while still further west, near Salamanca, New York, the red beds occur within an interval of some 250 feet below the Olean conglomerate (Pottsville?). At the same time the thickness of the red division has decreased from nearly 5,000 feet in Columbia County, Pennsylvania, to practically nothing in the northwestern portion of the Salamanca quadrangle in New York.

The two divisions of the red series in northern Pennsylvania, provisionally called the Catskill and Oneonta divisions, were described. The Oneonta division was shown to be some 300 feet thick in western Bradford County, Pennsylvania, and to be separated from the Catskill by 350 feet or more of typical marine Chemung. Some 25 miles further west, near Mansfield, the division is represented only by one or two thin beds occurring about 400 feet below the Catskill. Both the lower and upper limits of the Oneonta division were shown to be rising to the westward, indicating that the incursion of the sea and its marine fauna probably took place in Bradford County while red beds were still being deposited in Tioga County on the west.

In considering the age of the red beds at their extreme western limits near Salamanca, New York, it was shown that their stratigraphic position agrees with that of the Pocono in eastern Pennsylvania and with the Waverly in western Pennsylvania. A marked change of fauna, including the introduction of fifty new species, of which seven were of Carboniferous type, was shown to have occurred immediately below the red beds in the region just east of Salamanca, and was regarded as marking the beginning of a transition into the Carboniferous, or possibly the introduction of the Carboniferous itself. The proposition that these beds, with the included red shale, belong beneath the Waverly, and that the latter may have been entirely cut out in this region by the unconformity at the base of the Pottsville was regarded as possible, but as not established.

Mr. Thomas H. Means, of the Bureau of Soils, then presented a very interesting paper, entitled 'Some Results of the Soil Survey.'

Mr. Means reviewed briefly the development of soil studies in the United States and described the methods in use in the Bureau of Soils. Sixteen thousand square miles have been surveyed, the areas being generally distributed through the principal physiographic provinces of the country. A survey is now in progress in Porto Rico. Large areas have been surveyed in the irrigated lands of the western United States. In these areas, besides a study of the soils, the question of alkali in the soils has received particular attention and methods for the reclamation of the alkali lands have been worked out. The maps as issued by the Bureau are principally for the use of the farmers and therefore the classification of the soils is agricultural rather than geological. Mr. Means exhibited a number of soil and alkali maps and described their principal features.

Mr. F. C. Schrader presented a paper, entitled 'The Geological Section of the Rocky Mountains in Northern Alaska,' illustrated by lantern. The southern end of the section is on the Koyukuk River, a northern tributary of the Yukon, and it extends northward to the Arctic Ocean, following approximately the 152d meridian. Beginning at the southern end, the first hundred miles of the section traverses a dissected upland, made up of sandstones and slates and some limestones. These are known to be in part Lower Cretaceous beds, and the remainder are believed to be Cretaceous, or at least Mesozoic. North of this upland is a rugged mountain range, having a width of some eighty miles and reaching altitudes of some 6,000 feet.

Orographically this range is considered to be the northwestward continuation of the Rocky Mountains of the United States and of British Columbia, which here trend nearly east and west across northern Alaska, forming the great trans-Alaskan watershed between the Yukon on the south and the drainages of the Arctic Ocean on the north. On the south the rise from the rolling Koyukuk country to the mountains is rather abrupt; on the north the mountains break off abruptly, much as they do along the edge of the Great Plains in the western United States. Pronounced faulting and uplift are evidenced by marked deformation of the strata and the presence of prominent fault scarps, often miles in extent. A view across the top of the range has the general appearance of a dissected plateau or uplifted peneplain, whose former surface is marked by a sea of peaks which rise to a general level of about 6,000 feet, while the valley floors lie approximately at 2,000. The range, however, seems to be somewhat higher near its northern and southern margins than in its central mass. It may therefore be regarded as having two axes, each formed by the older Paleozoic rocks, which seem to mark lines of maximum uplift. Continued with diminishing height to the westward, the northern axis seems to terminate in the Paleozoic rocks which form the low mountains and set cliffs at Cape Lisburne, while the southern axis marks the watershed between the Noatak and Kobuk rivers. The rocks composing the range comprise several metamorphic series of limestones, slates, conglomerates, and some schists, ranging from Upper Silurian to Lower Carboniferous, and all much older than the rocks forming the rolling plateau country on either side of the range.

Along its northern base the range is met by a gently rolling plateau country, 2,000 feet high, composed of Lower and Upper Cretaceous beds. This plateau slopes gently to the north for one hundred miles, where it falls off to the Arctic coastal plain. This coastal plain is underlain by Tertiary beds of Pliocene and Oligocene. In the Cretaceous plateau country the aspect of the topography is softened by the presence of drift, showing glacial action to have extended nearly one hundred miles to the north of the mountains. The Colville, like other of the large rivers of northern Alaska, has by lateral migration so encroached upon its western bank that it now enters the ocean at a point approximately thirty miles west from where it debouched in late Tertiary or early Pleistocene time. Along the coast the margin of the coastal plain is fringed by tidal lagoons and embayments and dotted by lakelets. In the low bluffs and sea cliffs ground ice is in many places exposed. These ice strata rise to a height of twenty feet above sea level and extend inland for unknown distances, while the surface is mantled by a sheet of muck and moss but a foot or two in thickness.

ALFRED H. BROOKS,
Secretary.

CHEMICAL SOCIETY OF WASHINGTON.

THE 133d regular meeting of the Chemical Society of Washington was held March 12. The following program was presented:

Dr. W. F. Hillebrand: 'Common Errors in the Determination of Silica.' This paper was presented by Dr. Hillebrand at the winter meeting of the American Chemical Society, and was published in the April number of the *Journal of the American Chemical Society.*

Dr. E. T. Allen: 'Researches on the Oxides of Tungsten.'

1. When tungstic acid is reduced by stannous chloride at 100° C., or by hydriodic acid in sealed tubes at 200° C., the product is an indigo-blue powder of the composition $W_5O_{14}.H_2O$. This compound is changed to tungstic acid by most oxidizing agents. In hydrochloric acid it is insoluble. Caustic alkalies dissolve it with evolution of hydrogen and formation of alkaline tungstate. So far no salt has been obtained from it. Its formula agrees with that of the blue oxide of molybdenum, $Mo_5O_{14}.6H_2O$, recently studied by Guichard.

2. Concentrated ammonia extracts tungstic acid from the blue oxide, leaving a residue which is purple with a strong bronze luster. Its formula is $W_3O_8.H_2O$. The chemical properties of this body are similar to those of the blue oxide. Thus it is insoluble in hydrochloric acid, soluble in caustic alkalies with evolution of hydrogen, and more readily attacked by oxidizing agents than the blue oxide. It finds an analogue among the oxides of uranium ($U_3O_8.xH_2O$).

3. In composition and color these two oxides are closely related to the tungsten bronzes. Thus we have $W_5O_{14}.M_2O$, where $M_2=K_2$, Na_2, Li_2, or Ba, all *dark blue* in color; and $W_3O_8.M_2O$, where $M_2=Na_2$ or K_2, both having a metallic luster, while $W_3O_8.K_2O$, described by Hallopean as a reddish-violet powder with a copper reflex, recalls $W_3O_8.H_2O$ in a striking way. Direct transformation of these bronzes into the two oxides mentioned in this paper, or *vice versa,* has not been accomplished.

L. S. MUNSON,
Secretary.

BOSTON SOCIETY OF NATURAL HISTORY.

AT the general meeting of the Society held on February 5, 1902, the president made the formal announcement of the death, on January 15, of the Curator, Alpheus Hyatt. He spoke feelingly of his cordial and courteous personality, his unfailing good-humor and his deep interest in the development of the Society's work. At the close of these remarks, it was unanimously voted to request the Council to make arrangements for a memorial meeting for Alpheus Hyatt.

The paper of the evening was by Mr. George B. Gordon, who spoke of 'Recent Explorations by the Peabody Museum in Guatemala and Honduras.' He gave an account of the first expeditions by white men into this region, and pointed out that General Cortez, in his two years' march from the City of Mexico to Honduras, found the country a wilderness and had great difficulty in obtaining any provisions. A considerable amount of work has been done by the Peabody Museum of Archeology and Ethnology in uncovering and investigating the vast ruins of the Mayas, buried in the depths of the tropical forests of this region. The city of Copan, which has been to a great extent uncovered, appears to be the oldest of these ancient communities. A number of lantern slides was exhibited, illustrating the types of monoliths, altars and temples. Mr. Gordon also gave an account of an exploration of a large limestone cave, in which was found a very deep pit. With some difficulty the explorer was lowered into the pit, and found the floor covered with fragments of human bones. He suggested as a possible explanation of this fact that the cavern was used as a temple by the ancient tribes, and the bones were those of victims sacrificed to the Cave God, by being hurled into this chasm.

At the meeting of February 19, Professor W. O. Crosby presented a careful and detailed treatise on the 'Origin of Eskers.' He pointed out that the deposits classed as eskers have doubtless been formed under various conditions, and that a stationary ice-margin was highly favorable, if not essential, to such formations. The evidence of existing ice areas and glaciers seems to shed little light on the problem. The theories of esker formation were considered in detail, and the defects of the subglacial theory of origin were pointed out. A superglacial origin was considered to be much more probable. The material for such superglacial deposits could easily have been derived from englacial detritus, which, as is known, is constantly working up toward the surface of the ice, as the ice-sheet moves onward. This detritus would be acted upon by superficial streams. The ice-floor of a superficial stream is lowered by base-leveling, and by the melting away of the ice from below. The channel thus continues to aggrade, while at the same time the deposits consequent on aggradation are being let down, so that the final grade is that of the ground below. In further support of this theory, the speaker cited the general absence of any correlation of the meanders of eskers to the present topography, a fact which is almost inexplicable by the subglacial theory of formation. The material of these deposits, too, could hardly be so great as it is, if the subglacial theory be accepted, for a subglacial stream could have gained little from englacial drift, and not largely either from the ground moraine. In conclusion, Professor Crosby considered the eskers and sand plains of Newtonville and Auburndale, especially in their bearing on the two main theories of esker formation.

An account of an 'Entomological Collecting Trip in the Highlands of Bolivia,' from the advance sheets of a forthcoming work by Mr. A. G. Weeks, Jr., was read. A graphic description of the topography and general features of this almost unexplored region was given and several finely executed colored plates were shown, illustrating hitherto unfigured Lepidoptera. GLOVER M. ALLEN,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of the Academy of Science of St. Louis on the evening of March 17, Dr. E. R. Buckley, State Geologist of Missouri, addressed the Academy on the work being done by the State Bureau of Geology and Mines, giving a brief review of the work done by the Bureau in the past, since its creation in 1839, and an outline of the plans for the future.

At the meeting on April 7, Dr. A. S. Langsdorf, of Washington University, delivered an address on Electric Waves, the explanations being illustrated by experiments, including some of the phenomena of self-induction, absorption, reflection and resonance.

Dr. H. von Schrenk exhibited a sample of the impregnated wooden paving blocks used on some of the streets of London and Paris.

One person was elected to active membership.

WILLIAM TRELEASE,
Recording Secretary.

DISCUSSION AND CORRESPONDENCE.

SECTION D, MECHANICAL SCIENCE AND ENGINEERING OF THE AMERICAN ASSOCIATION.

THE next meeting of the American Association occurs at Pittsburg, June 28–July 3, of this year.

The various Carnegie and Westinghouse industries and a host of others in and about Pittsburg make this locality probably the most interesting in engineering lines in America. Admission to some of these plants is, under ordinary circumstances, difficult to secure. But strong local committees of influential men will do all that can be done to give visitors entrance wherever desired on the important occasion of the coming meeting. Local conditions, therefore, should make Section D, devoted to 'Mechanical Science and Engineering,' the most prominent of the Association.

It will have the active cooperation of the Engineers' Society of Western Pennsylvania—a powerful organization of 404 members. Prominent investigators in various parts of the country have already signified their intention to participate.

The order for the week will be short, crisp, pithy papers for the morning sessions and carefully planned educational excursions under competent local leadership for the afternoons.

This notice is sent out to engineers everywhere and a cordial invitation is extended to them to send to the secretary as soon as convenient titles and abstracts for the morning programs.

The American Association opens at Pittsburg on Saturday, June 28. On Thursday, Friday and Saturday of the same week the Society for the Promotion of Engineering Education will also meet in the same city. A rare series of meetings is in store, therefore, for those who attend, and it is hoped that very many engineers will put Pittsburg on their summer schedule. Please remember to send titles and abstracts very soon to the secretary.

J. J. FLATHER, *Chairman,*
C. A. WALDO, *Secretary.*
LAFAYETTE, INDIANA.

SECTION A, MATHEMATICS AND ASTRONOMY.

Members of the Association who will have papers to present before Section A at the Pittsburg meeting, June 28–July 3 next, are requested to send the titles of such papers as soon as possible to the Secretary of the Section.

EDWIN S. CRAWLEY.
UNIVERSITY OF PENNSYLVANIA.

CENTRAL CONTROL OF THE EXPERIMENTAL STATIONS.

THE article on the above subject by H. F. Roberts, in a late issue of SCIENCE, urges a point of view in some respects plausible, but not, I think, in accord with the best interests of either the scientific or the practical aspects of the station work; unless it be from the standpoint of the trite saying that the best government would be that of a wise and benevolent despot. And surely, if it is bad for the West to have stations established ten or seventy miles apart, it is worse for the East, where the stations, *e. g.*, of the New England states, and of Delaware, Maryland and New Jersey, are located so closely together within a remarkably uniform climatic region, while similar distances on the Pacific slope will often involve the most startling climatic contrasts. By parity of reasoning, the central authority called for ought to abolish and redistribute a dozen of these stations of the Atlantic coast region; and logically, the abolition of 'Little Rhody' and similarly small states, which are exceeded in area by many single counties in the West, should follow in due course, the political preponderance given them at present being clearly unfair.

Robert's fundamental idea, that stations should be located so as to represent climatic and soil regions instead of state lines, is undoubtedly correct, and there is no excuse for the close proximity of the Washington and Idaho stations, as there is plenty of elbow-room in both states. The local and political 'pulls' exerted for the location of stations, without reference to fitness, is unquestionably a crying evil. But the same applies to a hundred other subjects of state legislation, including normal schools, asylums of all kinds, and even penitentiaries. The taxpayers' money is wasted in these useless duplications; and all this could be avoided if we had the wise and benevolent despot, who would arrange and handle these matters in accordance with common sense, economy and 'the greatest good to the greatest number.' But, until we find that highly gifted person, we must submit to what is simply a part of the price we have to pay for democratic institutions.

It is, or assuredly should be, one of the main objects of the stations to investigate, first of all, the problems that interest their respective constituencies. The fact that they are partially dependent for their income upon state appropriations is a wholesome admonition to conform to this reasonable expectation; on the other hand, the supervision of the national Department of Agriculture is an equally wholesome restraint upon improper use of their funds. But that Department has not now, and will not have for a long time to come, the intimate knowledge of the entire enormous area of the United States that would be necessary to determine advisedly the best direction to be given to the energies of each of the numerous stations. However well assured we may be of the benevolence of the Department, it has not had the time or means to acquire the wisdom which is the other necessary postulate of the good despot. Those whose work is done thousands of miles away from Washington have reason to know this; *e. g.*, it is only within the last few years that the necessity of having seeds to be tested in California, on hand by the middle of January at the latest (and in many cases by the first of October), has been appreciated and acted upon at the national headquarters, although the present writer had made annual representations to that effect for over twelve years. The usual quadrennial changes in the Secretaryship of Agriculture render the recurrence even of this very infelicity (not to mention others) a contingency far from remote.

To quote the language of the excellent report of the committee on cooperative work between stations and the Department of Agriculture: 'Not only is the autonomy of the stations necessary for the fulfilment of their functions, but autonomy in scientific investigations is essential.' And to quote still farther, a late distinguished visitor from Europe said that 'the danger of republics is corruption; that of monarchies is routine.' The present organization of the stations seems to me to provide against both, as far as is practically feasible. The mislocation of stations will in time cure itself, at the expense of the sinning states, who are bound to keep the federal or 'Hatch fund' intact; and meanwhile there is plenty of work to do for even such stations right where they are. Nay, if we are to take the dicta of some of our eastern station men literally, it should make little difference where they are located, so long as they are to confine themselves to the expansion of the '*science* of agriculture' only. Fortunately, few of the western stations have held this view, and fewer have acted upon it. With a multitude of new practical problems before them, and a constant demand for information involving a knowledge of local conditions in unexplored territory, a policy differing in important points from that of eastern and European stations becomes a necessity; and while the Department at Washington may justly object to having the 'Hatch fund' so subdivided among regional substations as to become inefficient for good work, the need of these substations is nevertheless felt by all workers where, as in a large portion of the West, cultural conditions are more radically different within short distances than is the case anywhere between the Atlantic seaboard and the Mississippi. The state stations are naturally in the best position to know and appreciate these differences, and can most intelligently act upon them; while there is no organized instrumentality whereby the Department at

Washington could acquire such knowledge. Much can be done by cooperation, so long as this does not degenerate into invidious competition; but the autonomy and initiative of the stations are assuredly the best means of maintaining their usefulness to the people of their several states, and to the progress of agricultural science in its widest sense, viz., its application to the actually existing conditions, even though these may appear 'abnormal' to the dwellers in the temperate humid regions where that science has been first developed. E. W. HILGARD.

UNIVERSITY OF CALIFORNIA,
March 24, 1902.

THE SUBMARINE VALLEYS OF THE CALIFORNIA COAST.

IN SCIENCE for January 10, Professor Wm. E. Ritter, reporting the dredging work done last summer off the coast of southern California, states that 'the bottom deposits of some, at least,' of the submarine valleys which characterize the California coast, 'even at a distance of several miles from shore, are of a character to prove that close inshore material is carried into them in large quantities.' And to him this 'observation suggests, though of course does not prove, that the valleys are natural channels through which currents flow, at times, at least, from *the shore out to deeper water*.'

On entirely different grounds, the present writer had reached a somewhat similar conclusion—that the majority of the submarine channels of the California coast have been formed, or are at least kept open, by some cause now in operation, and that cause coastal currents. These views and the reasons for them were given by the writer in a paper read before a meeting of some members of the U. S. Geological Survey, about a year ago; they can be only briefly outlined here.

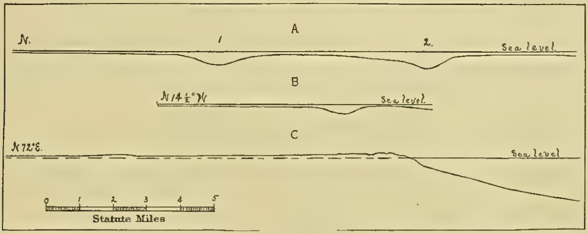
The mature Coast Ranges of California, taken as a whole, lie close to and parallel with the coast line, and the coastal topography is therefore rugged. As the larger stream courses follow the trend of the ranges and the coast for long distances, there are few coastal breaks of importance. Fringing this rugged coast and the coastal islands is a narrow submarine terrace or platform, the 'continental shelf,' which has been formed mainly by marine abrasion, and whose outer margin is marked approximately by the 100-fathom submarine contour. Its width ranges from a minimum of about a mile to a maximum of about thirty-two miles, the average being between five and ten miles. The submarine valleys (of which between twenty-five and thirty have been described along the Pacific coast of California and Lower California) notch this terrace and its outer escarpment. The valleys, for the most part, begin at or near the shore line and continue to depths ranging from about 400 feet to more than 3,000 feet, the majority descending to at least 2,000 feet. Most of the valleys follow a course roughly at right angles to the shore. Their forms are both simple and branched. Some of them head opposite the mouths of large valleys on the land, and some opposite abrupt and rugged portions of the coast, where there is no break in the Coast Ranges. The valleys in general are quite open, none of them being 'chasm,' as is frequently supposed. This may be easily seen in the cross sections of the valleys. While the general slope of their walls differs considerably, in any given case it is comparatively gentle, taken as a whole. Two cases of unusual steepness have an angle of only about 20°, while the maximum angle measured was about 31°, in Cape Mendocino valley. The grade (profile) of the valleys is considerably greater than that of the lower parts of the larger coastal valleys. Vincente valley, from the shore line to a depth of 1,800 feet, has an average grade of about 260 feet to the mile, while the grade for the first quarter-mile from shore is about 720 feet to the mile.

Two explanations of these submarine valleys have been proposed: one that they are structural in origin (Lawson); the other that they are submerged stream valleys (Le Conte, Fairbanks, Davidson).

There can be little doubt that *some* of the valleys are due to coastal deformation; but this interpretation is unsatisfactory in accounting for the majority of them, for the following reasons:

(1) Many of the more important valleys *stop abruptly at or near the shore line,* and no corresponding valley or depression exists on the land, so far as known; nor (2) are there, except in a very few instances, corresponding embayments in the coast line, as there should be if the valleys are of comparatively late origin, and especially if developed subsequent to the formation of the 'continental shelf' (submarine platform).

(3) The submarine platform, except in one or two places, shows nothing that could be interpreted as warping in their neighborhood, as responding submarine channels. (2) Where they are opposite important valleys on the shore, the submarine valleys do not correspond to them in size, shape or grade. (3) The submarine platform, in the case of many of the more important valleys, has not been developed through cutting between the head of the valley and the shore, nor have the heads of the valleys been filled in with sediments, even in regions of deposition. Two of the valleys head near the points of cuspate forelands, the valleys, in both instances, running in close to the beach. A third valley



A. Section across (1) Cape Mendocino and (2) Punta Corda submarine valleys, where the valley bottom of the former has a depth of 2,000 feet, and of the latter a depth of 2,400 feet.

B. Section across Vincente submarine valley, where the valley bottom has a depth of 1,500 feet.

C. Profile of Vincente submarine valley and of the mainland along the same general line. Vertical scale in *C* five times horizontal.

it should if they were of subsequent development. (4) On the other hand, unless the valleys belong to the very latest stage of coastal development, the submarine platform should be developed between the head of the valley and the shore, or the head of the valley should be filled with shore detritus. This is not the case with most of the valleys.

(5) The objection raised by Fairbanks that their course is transverse to the principal structural lines of the coast, appears to the present writer to have little weight, since minor structural lines might occur at any angle with the main lines.

The interpretation as submerged stream valleys is also unsatisfactory because: (1) The submarine valleys do not, in general, correspond in position to valley openings on the shore, and, *vice versa,* the coast drainage lines (except in a very few instances) have no corheads near a form having the general appearance of a blunt cusp. If the submarine valleys were developed prior to the formation of the platform, they would have been modified by its development; if subsequently developed (as stream valleys), it should be possible to trace them inland, and there should be corresponding embayments in the coast line.

In view of the fact that so many of the valleys (about one-half) stop abruptly close to the present shore line, it would hardly seem that this could be accidental, and the reason for it is the critical point in attempting an explanation of the valleys. This fact, together with the other objections given above, would point to the conclusion that some of the valleys at least must be wholly or partly due to present causes. The only cause capable of producing such results—keeping the valley head open close to shore in the face of active cutting or deposition—would seem to be coastal currents of some sort. Such currents must be either marine, or else subterranean streams from the land, and it does not seem altogether unlikely that they might be the latter. The emergence of subterranean streams might at least account, in some cases, for the absence of deposits in the valley heads and their nearness to the shore, if not for the formation of the valley as a whole. The occurrence of an oil well in Vincente valley near its head is significant in this connection. The larger pre-Pliocene valleys of the Pacific coast, which were much deeper than those of the present time, were filled to a greater or less extent during the Pliocene depression of the coast, and have been as yet only partially re-excavated. There are therefore at intervals along the coast, deposits of loose materials extending to a considerable depth below sea level, and through these, underground waters, under sufficient head, might find a submarine outlet.

It is possible that many if not most of the valleys are due, not to any one cause, but to several causes which have all contributed to their formation or preservation. Much careful and detailed investigation is necessary before the problem can be solved, and the statements made here are intended as suggestive rather than final. Such work as Professor Ritter reports gives valuable information. Observations in the vicinity of the valleys on surface currents, their strength, direction and persistence, and on the temperature and salinity of the surface waters, and also similar observations made, as far as possible, near the bottoms of the valleys and in their neighborhood, as well as a study of the materials covering their floors, might throw much light on the question of their origin. Further than this, detailed geological study of the mainland adjacent to the valleys is necessary. The physiographic conditions, both subaerial and submarine, have been taken into account, to a certain extent, in this discussion, but a fuller knowledge of them is needed. Finally, as has been stated elsewhere by the writer, each valley must be considered by itself, since the explanation for any one is not necessarily the explanation for all.

W. S. Tangier Smith.

Washington, D. C.

SHORTER ARTICLES.

HOW MANY ONE-DOLLAR BILLS WILL EQUAL IN WEIGHT A FIVE-DOLLAR GOLD PIECE?

If the reader will answer the above question in his own mind before going further he will better appreciate what follows. This question was asked of a number of students and professors, and the answers recorded. The answers were surprising and for the most part extravagant. It seems that the idea of value is so prominently associated with currency that definite ideas of weight are somewhat wanting, although most people have fairly correct ideas of the weight of paper in other forms. The number of persons answering the question was 97. The average estimate was 2,291 bills, the median estimate was 45. In order to see if there is any tendency to confuse the categories of value and weight unconsciously, other persons were asked to answer the question: How many five-dollar bills will equal in weight a five-dollar gold piece? Some were asked a similar question with reference to twenty-dollar bills. Putting the fives and twenties together, there were 74 answers given. The average estimate was 97, the median 25. The great difference in the averages is due to a half dozen very large answers to the first question, but these do not materially affect the median estimates, which are the really significant figures. The answers are all from males. A number of answers were given by female students, but their answers, either by chance or by nature, were of such a great variety—ranging from one to one million—that it seemed best to leave them out in making the comparison. After these calculations were made I received answers, through the kindness of Professor Templin, of the University of Kansas, from two divisions of a class of both sexes. The figures with reference to the one-dollar bills show an average of 2,749, and a median estimate of 99, while with the five-dollar bills the average was 492, and the median 50. It is interesting to note that the ratio of the median estimates in the two sets is approximately the same. The number of bills actually required is a little less than seven.

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RECENT PROGRESS IN PETROLOGY.

CHEMICAL CLASSIFICATION OF ERUPTIVE ROCKS.

OSANN, in a recent paper (Tschermak's *Min. u. petrographische Mitth.*, Bd. XX., pp. 399–588, 1901), has carried out with reference to the effusive rocks the principles of classification which in an earlier publication (*Ibid.*, Bd. XIX., pp. 351–470, 1900) he applied to the plutonic rocks. It is his avowed intention to discuss in a third contribution the application of the same principles to the dike rocks.

The chemical compositions of the rocks are expressed by the general formula

$$s_v a_w c_x f\, n_z$$

where

s = the molecule SiO_2.

a = the atomic group $(NaK)_2Al_2O_4$.

c = the atomic group $CaAl_2O_4$.

f = the atomic group (FeMnMgSrBaCa)O.

n = the proportion of soda molecules when the relative numbers of soda and potash molecules in the rock are calculated to a sum of 10.

v = the number of molecules of silica when the ordinary molecular ratios of the rock analysis are calculated to a sum of 100.

w, x and y = the proportions of each of their respective atomic groups, when all three are calculated to a sum of 20.

z = the numerical value of the soda proportion n.

In these two papers 207 analyses of plutonic and 403 analyses of effusive rocks are considered and the corresponding rock formulas calculated. From these formulas the rocks are plotted upon triangular projection paper, the elements of the projection being a, c and f.

The carrying out of this plan has involved much labor, and if the result is somewhat disappointing it has at least the full value of recording a careful and sustained experiment. It is to be regretted that the author has modestly restricted his attempt at classification to setting up types within the groups and families of the Rosenbusch classification. It is partly owing to this acceptance of a scheme which has grave objections and which is based on principles little in common with those on trial in this essay, that the latter falls short of more conclusive results. For example, it is seen that the formula of the 'Klausen type' of the diorites is identical with that of a granite intermediate between the 'Syene type' and 'Kamm type,' and similar cases are found among the formulas of the basaltic andesitic and allied rocks of the effusives.

Inspection of the diagrams fails to show any grouping of the effusive rocks upon which classification might be based. In the plutonic rocks the anorthosites alone show some tendency in the graphic projection to form a distinct family. The silica does not appear in the method of plotting here used, and the result is hardly so graphic and satisfactory as that employed by Brogger in his 'Ganggefolge des Laurdalits.'

GNEISSES OF THE SCHWARZWALD.

IN continuation of his studies of the crystalline metamorphic rocks of Baden, Rosenbusch (*Mitth. der Grossh. Badischen Geologischen Landesanstalt*, IV., pp. 367–395, 1901) gives detailed petrographical descriptions and chemical analyses of the para-augite and para-amphibole gneisses of the Schwarzwald, the prefix *para* signifying their derivation from former sediments. The augitic gneisses range from quartzose or psamitic types, to those free from quartz. It is concluded on chemical grounds, supported by geological relationships, that these gneisses have been formed by the metamorphism of calcareous sandstones, dolomitic calcareous shales and clayey marls. The hornblendic gneisses were derived from a ferruginous dolomitic marl containing quartz and rutile.

These interesting studies, which recall those of Adams on the Grenville Series of Canada, constitute a substantial step toward a more precise knowledge of the real nature and origin of the Archæan complex. The need of modern analyses of typical unaltered sediments for purposes of comparison with crystalline metamorphic rocks in these and similar investigations is rendered apparent.

SEQUENCE OF VOLCANIC ROCKS.

In a paper by Lawson and Palache on the Berkeley Hills, California (*Bull. of the Dept. of Geology,* Univ. of Calif., Vol. 2, pp. 349–450, 1902), the microscopical petrography of a series of andesitic, basaltic and rhyolitic lavas is described in detail. The most interesting petrological feature brought out in their description, however, is the remarkable fivefold repetition of the eruption of andesite, basalt and rhyolite, in the order named. As the authors cautiously point out, the small size of the area considered (less than six square miles) renders it possible that the perfection of this periodicity is accidental, but this commendable reserve does not deprive the fact of its importance and significance. The paper, as a whole, is a successful attempt to present to students a detail of the remarkably rich geological field which surrounds the University of California.

F. L. Ransome.

THE ALASKA FUEL SUPPLY.

In closing his discussion of the coal resources of Alaska, in Part III. of the Twenty-second Annual Report of the United States Geological Survey, now in press, Mr. Alfred H. Brooks adds some brief comments on the other sources of fuel. In addition to coal, he says, there are three possible sources of fuel supply in Alaska, namely, timber, petroleum, and peat; and of these, timber alone has been utilized. Southeastern Alaska is heavily forested and affords ample wood for fuel. Certain species of trees are found as far west as Kadiak Island. Beyond Kadiak, to the west and north, the coast-region of Alaska is practically treeless. Some willows, and occasionally spruce, are found in the sheltered regions; but for the most part the coastal belt is covered simply with moss, grass and low shrubs. This type of vegetation extends northward to Point Barrow and thence eastward. The moss and grass-covered plains and the rolling plains are called *tundras,* and are found on the northern continental margins encircling the globe.

The interior of Alaska has usually a sufficient supply of wood for ordinary purposes of building and mining and for fuel. The larger river valleys are often heavily forested with spruce and other trees. On the Yukon, near the international boundary, the timber line is at about 3,000 feet; northward it decreases in elevation, and on the Koyukuk it is about 2,500 feet. Still further to the north and west it further decreases in altitude, and on the Upper Kobuk the timber is said to be limited to the floor of the largest river valleys. In the northern Arctic drainage reports state that there is no timber except the willows, which however grow to considerable size. The Kuskokwim, Sushitna and Copper rivers all have timber basins. During the great influx of population of the last three years, much timber has been destroyed by fire in the dry summer months. In the northwestern and northern parts of the territory, from Norton Bay around to the mouth of the McKenzie, the shore was once abundantly supplied with driftwood. The Eskimos, who have been using this wood for generations, are very economical in the matter of fuel, and, until the coming of the white man, the probabilities are that the driftwood was accumulated faster than it was used. This driftwood is brought down from the interior by the larger rivers, whose banks are wooded. The cutting of the wood along the banks of the Yukon has already decreased the annual contribution of driftwood to northern Bering Sea. This, together with the rapid exhaustion by the white man of the supply which had accumulated in the past, will soon cause the Eskimo as well as the white man to be dependent on other sources for fuel. The North Arctic Coast eastward from Point Barrow, which is but thinly populated by natives and seldom visited by whites, has some driftwood. The possibilities of using for fuel the thick growth of vegetable matter which covers most of the treeless regions of Alaska have been suggested, but have never been put to practical test. During the months of June and July, 1900, extensive fires swept through much of the treeless region of Nome and other portions of the Seward Peninsula. The moss and grass, when dry, were found to burn rapidly with considerable flame, and fires ran over nearly the entire region visited by prospectors during the dry months. This fact makes it evident that the surface growth of the tundra could be used for fuel, provided it were properly dried. This material has in many cases been accumulated to considerable thickness in peat bogs. With regard to the third source of fuel supply, petroleum, we have no definite knowledge of its existence in commercial quantities. It is reported to have been found in southeastern Alaska, between Yakutat and Controller bays, south of Mount St. Elias, and also on the east side of Cook Inlet near Kachemak Bay.

CRUISE OF THE ALBATROSS.

The Fish Commission steamer *Albatross*, which sailed from San Francisco on March 11, arrived at Honolulu on March 24, as noted in Science of April 11. Heavy weather was encountered almost immediately after leaving port, and on the 12th the quartermaster of the watch was lost overboard while taking the reading of the patent log. Much interesting pelagic material was obtained with surface and intermediate nets on the outward voyage. An attempt, extending over two days, to determine the nature of the life on Erben Bank was unsuccessful, as the peculiar laval formation of the bottom resulted in the loss of all the trawls and other appliances used and subjected the dredging cable to an unprecedented strain.

The surface collecting off Waikiki on March 27 by the aid of electric light is reported by Dr. Gilbert to have been probably the most successful work of the kind ever done. Among the creatures thus obtained is a remarkable animal, first identified as a crustacean, afterwards called a worm, and finally considered a vertebrate; its eyes are on stalks half an inch long.

SCIENTIFIC NOTES AND NEWS.

Dr. Daniel Coit Gilman, president of the Carnegie Institution, sailed for Europe on April 17, with a view to studying foreign scientific institutions.

Professor William James is at present abroad, in order to give his second course of Gifford lectures at Edinburgh. Dr. Gwatkin, professor of ecclesiastical history in the University of Cambridge, has been appointed to succeed Professor James as Gifford lecturer.

Professor Solon I. Bailey, of the Harvard Astronomical Observatory, is about to leave for the observatory's branch at Arequipa, Peru, where he will especially study the planet Eros.

Dr. W. H. R. Rivers, of Cambridge University, will shortly start on an expedition for the psychological study of the Todas of southern India on the lines of his work in Torres Straits.

M. T. Obalski has been sent by the French Government and the Paris Museum of Natural History to Canada to make collections and study the natural history and industries of the country.

Professor Franz Soxhlet, of the Munich technical school and director of the agricultural experimental station, has been made chevalier of the Order of Merit of the Bavarian Crown.

A volume has been published commemorating the jubilee celebration in honor of M. Berthelot, held on the twenty-fourth of November last. Copies of the plaque struck in his honor have been presented to all members of the French parliament.

We noted in our last issue that Professor Keen, of Philadelphia, had been made an honorary member of the German Surgical Association at its thirty-first Congress. The other honorary members were Professors Bergmann and König, of Berlin, Professor Guyon, of Paris, Professor Durante, of Rome, and Professor MacEwen, of Glasgow.

Joseph J. Kinyoun, M.D., Ph.D., late surgeon of the Marine Hospital Service and director of the Hygienic Laboratory at Washington, assumed the directorship of the biological laboratories of the H. K. Mulford Company at Glenolden, Pa.

It is planned to found at Edinburgh University a laboratory in memory of the late Professor Tait. A subscription of £1,000 has been received.

Professor Hans Büchner, the eminent bacteriologist, died at Munich on April 5, in the fifty-second year of his age.

The following amendments to the Sundry Civil Appropriation Bill have been proposed in the Senate: An amendment proposing to appropriate $5,000 for the preparation of preliminary plans for an additional fireproof building to cost not exceeding $2,500,000 for the United States National Museum; an amendment proposing to increase the appropriation for the expenses of the system of international exchanges between the United States and foreign countries, under the direction of the Smithsonian Institution, from $24,000 to $29,800; an amendment proposing to increase the appropriation for continuing the preservation, exhibition, and increase of the collections in the National Museum from the surveying and exploring expeditions of the Government from $180,000 to $200,000; an amendment proposing to increase the appropriation for the National Zoological Park at Washington, D. C., from $80,000 to $110,000, and providing that $20,000 of this amount shall be expended in the construction of a boundary fence, including entrance gates; an amendment proposing to appropriate $20,000 for the construction of an elephant house at the National Zoological Park, Washington, D. C.; and an amendment proposing to appropriate $25,000 for the construction of an aquarium building at the National Zoological Park, Washington, D. C.

The U. S. Civil Service Commission announces an examination on May 15, for the positions of botanist in charge of grain investigations and of assistant curator in the Bureau of Plant Industry. The salary of each position is $1,800. An examination will also be held on May 6 and 7 for the position of field assistant in forestry in the Bureau of Forestry at a salary of $1,000.

The executive committee of the Carnegie Institution held a meeting at Washington on April 15.

Professor W. R. Brooks, director of the Smith Observatory at Geneva, N. Y., announces the discovery of a comet in the constellation Pegasus. The comet has been observed at the Lick and Kiel Observatories.

Professor von Leyden claimed before the German research committee on cancer, at Berlin, on March 21, the discovery of the microorganism of cancer. He concluded by the assertion that 'cancer is an infectious disease, dependent on parasitic organisms (protozoa) identical with those discovered by him and exhibited to the meeting.'

The board of estimate of New York City has authorized the issue of bonds for public improvements giving $250,000 to the Zoological Park and $150,000 to the Botanical Garden.

Mr. Andrew Carnegie has made the Public Library Board of Cincinnati an offer of $180,000 with which to erect six new branch library buildings in different parts of the city. He stipulates that the Board shall supply $18,000 a year for the maintenance of the proposed branches.

Dr. V. Guaita has given 15,000 Marks to the University at Freiburg for a fund to aid in supporting scientific expeditions.

As we learn from the *British Medical Journal,* the Prussian Government has voted 26,000 Marks for lecture courses in hygiene, forensic medicine, and psychiatrics which are to be held in Berlin for the benefit of the district health officers. Professor Koch and his assistants will take charge of the hygiene course (chief stress to be laid on the prevention of epidemics); Professors Jolly and Moeli will undertake psychiatrics, the former in his department at the Charité, the latter in the Herzberge Asylum. The courses are to be gratis, and the hearers will receive a fixed sum for traveling and lodging expenses. If these courses should prove as successful and useful as is hoped, they are to be repeated, and may grow into a permanent institution.

As announced last year, the association for maintaining the American women's table at the Zoological Station at Naples and for promoting scientific research by women offers a prize of one thousand dollars for the best thesis, written by a woman, on a scientific subject presented before December 31, 1902. A second prize of one thousand dollars is now announced by the same association. The theses offered in competition are to embody new observations and conclusions based on independent laboratory research in biological, chemical or physical science, and are to be in the hands of the chairman of the prize committee, Mrs. Ellen H. Richards, Massachusetts Institute of Technology, Boston, Mass., before December 31, 1904.

WE regret to learn that the Mayor of San Francisco has removed the Board of Health of that city on the alleged ground that their report of the presence of the bubonic plague in that city was incorrect.

THE *British Medical Journal* states that the Congress of the Association of French and Foreign Anatomists opened at Montpellier on March 24, under the presidency of M. Sabatier, dean of the faculty of science. About sixty delegates from various parts of France and from Switzerland, Belgium, Spain, Italy and Germany took part in the proceedings. A number of interesting papers were read. The principal feature of the Congress seemed to be a desire to establish a closer union between anatomy and physiology, between the study of the structure of an organ and its function.

ARRANGEMENTS have been made for a nature study exhibition to be held at the gardens of the Royal Botanic Society, London, on July 23 and following days. It will be open to colleges and schools of every grade, and the exhibits will include all that bears upon nature study. Various technical institutions and other educational authorities have arranged to defray the cost of the conveyance to exhibits from their respective areas, and preliminary exhibitions for the purpose of selecting the best material to send are being organized.

THE valuable medical library of the late Professor von Ziemssen, containing twenty-five thousand boods and pamphlets, has been purchased by the Leipzig bookseller, Gustav Fock. It would be an advantage if the library could be secured for an American institution.

A DESPATCH to the New York *Herald* from Montevideo says that news has been received from the Swedish Antarctic expedition under Dr. Otto Nordensjöld. The expedition has disembarked at Snow Hill, Louis Philippe Land, accompanied by the surgeon, Dr. Eklof, the Argentine Lieutenant Sobral and two sailors, one of whom was a member of the Duke of Abruzzi's Arctic expedition. From Cape Horn Dr. Nordenskjöld's vessel, the *Antarctic,* tried to sail directly south, but it enoountered too many icebergs, and there was danger of the ship being imprisoned in the ice for a long time. Dr. Nordensjöld then decided to change his course. His expedition will remain at Snow Hill until next summer.

M. ADRIEN DE GERLACHE, the Belgian navigator whose expedition to the south Antarctic five years ago will be remembered, is contemplating another voyage on a more extensive scale. M. de Gerlache hopes to leave one of the French ports in September of next year, when a vessel will be fitted out at the expense of a French capitalist.

THE auxiliary barque-rigged yacht, *Morning,* which is now being fitted out under the direction of Sir Clements R. Markham, president of the Royal Geographical Society, for the Antarctic Relief Expedition, will sail under the flag of the Royal Corinthian Yatch Club, and will lie off the club-house at Port Victoria until ready to start.

THE New York Botanical Garden announces the spring lectures for 1902, to be delivered in the Lecture Hall of the Museum Building of the Garden, Bronx Park, on Saturday afternoons, at 4:30 o'clock, as follows:

April 19, 'The Maples and other Early-flowering Trees': CORNELIUS VAN BRUNT.

April 26, 'Plant Life of the Sea': Dr. MARSHALL A. HOWE.

May 3, 'Botanical Features of Porto Rico': Professor L. M. UNDERWOOD.

May 10, 'Some Examples of Botany in its Relation to Geology': Dr. ARTHUR HOLLICK.

May 17, 'Wild Flowers, the Necessity for their Preservation': Mr. CORNELIUS VAN BRUNT.

May 24, 'The Cottons': Dr. H. H. RUSBY.

May 31, 'Cactuses and Cactus-like Plants': Dr. N. L. Britton.

June 7, 'Favorite Flowers of Nations and Poets': Professor E. S. Burgess.

June 14, 'The Vegetation of American Deserts': Dr. D. T. Macdougal.

The lectures will be illustrated by lantern slides and otherwise. They will close in time for auditors to take the 5:38 train from the Bronx Park railway station, arriving at Grand Central Station at 6:04.

The Rome Correspondent of the London *Times* reports that Signor Boni, director of Excavations in the Roman Forum, has made another discovery of unusual interest. It has long been his conviction that the subsoil of a part of the Forum contains the necropolis of the founders of Rome and that, given the Aryan origin of those founders, the character of the tombs must be in accordance with the Aryan custom of cremation. Critics have displayed much scepticism concerning this theory, as also concerning the traces of Aryan development which Signor Boni has detected in the Forum; but he has once more silenced their objections by producing the object whose existence they had doubted or denied. He has discovered a prehistoric tomb, believed to date approximately from the eighth century B.C., containing a large urn, or *dolium,* of black ware full of calcined bones, and several reticulated egg-shaped vases, besides a bowl and a cup with horned handles like those found in the *terremare* of the bronze age. The tomb is situated in the bed-clay some twelve feet below the level of the Sacred Way, opposite the Regia, and close by the Temple of Antoninus and Faustina. In some respects this discovery is the most important yet made in the Forum. One tomb is not a necropolis, but it is presumptive evidence of the existence of others. Unless the Italian Government should, to its shame, restrict the funds necessary for the exploration of the lower *strata* of the Forum, the point will soon be settled. Meanwhile, it is to be noted that the reticulated vases of the tomb bear a striking resemblance to netted gourds, and that the covering of the funeral urn is a faithful reproduction of a conical hut roof—signs that they date from a primitive period. The tomb may be regarded as the extreme link in the further end of the chain of Roman history, as reflected in the Forum and illustrated by Signor Boni in the discoveries of the *cippus* under the Black Stone, the Rostra, the ritual pits, the massive Republican drains (beside which the Cloaca Maxima seems insignificant), the extraordinary underground gallery for scene-shifting, the Lacus and the Fons Juturnæ, the Sacred Way, the Heroon of Cæsar, the Regia, the house of the Vestals, the Basilica Æmilia, and the Church of Santa Maria Antiqua—to enumerate only the more important of his astonishing results.

The London *Times* states that the Lightning Research Committee, which was organized in January, 1901, by the Royal Institute of British Architects and the Surveyors' Institution for the purpose of obtaining accurate records of the action of lightning strokes on buildings, with a view to improving if possible the means of protection, has enlisted the services of over 200 competent observers in the United Kingdom, besides a considerable number in the colonies and India and in foreign countries. The War Office, the Home Office, the Post Office, the Trinity House Corporation and the United States Department of Agriculture have signified their willingness to furnish the committee with the required particulars of damage to buildings under their control resulting from lightning stroke. The heavy thunderstorms of last year afforded numerous opportunities of investigating and recording, upon lines laid down by the committee, the damage caused by lightning to buildings within their area of observation. The net result so far is a series of some 70 or more trustworthy records, which furnish promising material for the committee to work upon when sufficient *data* have been collected to enable them to formulate their conclusions. The committee make a point of getting photographs immediately after the occurrence of a disaster in cases of importance. Out of 60 cases tabulated by the committee up to the end of December, 1901, no fewer than 12 relate to buildings fitted with some form of lightning conductor. As regards the system recommended by the Lightning Rod Conference of

1882, *data* to hand are not at present complete enough to afford a practical test of its efficacy. The recently issued report, however, of His Majesty's inspectors of explosives goes to show that the system has been found wanting, and that there is ample justification for the present inquiry. Besides the grants made by the Institute and the Surveyors' Institution, the committee has been aided financially by the government grant committee of the Royal Society and by the Royal Meteorological Society. Valuable help has also been given by the Royal Institute of British Architects, the Surveyors' Institution, the Institute of Electrical Engineers and the Royal Meteorological Society by circularizing their members with a view to getting observers. The committee is constituted as follows: Mr. John Slater, chairman; Major-General E. R. Festing, C.B., F.R.S., Mr. J. Gavey, M.I.C.E., General Post Office; Mr. W. P. Goulding, F.R.G.S., F.S.I., Dr. Oliver Lodge, Birmingham University; Mr. W. N. Shaw, F.R.S., Mr. H. Heathcote Statham, Mr. A. R. Stenning, F.S.I., Mr. Arthur Vernon, F.S.I., Mr. Killingworth Hedges, M.I.C.E., hon. secretary.

The Secretary of Agriculture has drawn up at the request of the Senate a report on the extinction of the American bison, in which he says: (1) The American bison is on the verge of extermination. Scarcely a handful now remain of the millions which formerly roamed over the plains of the West. (2) So far as the department is aware only two small herds of wild buffalo are in existence in the United States * * * one in the Yellowstone Park, the other in Lost Park, Colo. During the past autumn several of the latter were killed, and while the department has no recent information as to the exact number of animals in these herds at the present time, it has reason to believe that the Yellowstone herd does not exceed 25 and the Lost Park herd eight or ten individuals. (3) There are no wild buffalo in Canada, except in the Peace river country, where a few woodland buffalo, believed to be a different species from our plains buffalo, still exist. (4) A number of buffalo have been domesticated and half-domesticated. In addition to the small herds in zoological parks and in the hands of private individuals there are three important herds—the Corbin herd on the game preserve of the Blue Mountain Forest Association in New Hampshire, the Allard herd on the Flathead Indian reservation in Montana, and the Goodnight herd (containing about a hundred cross-breeds) at Goodnight, Tex. (5) Both the Allard and Goodnight herds consist in part of cross-breeds known as 'cataloes' obtained by crossing buffalo bulls with domesticated cows. Mr. C. J. Jones, the originator of this breed, states that he has succeeded in crossing the buffalo with almost all the different breeds of cattle, but that he considers the Galloway and the Polled Angus the best for this purpose. (6) Recent information indicates that the Allard herd is being broken. Thirty-five animals were sold last year, and a number of others within the past few months. If the government could acquire possession of these buffaloes they might be placed on some reservation under competent management, and if properly protected could be preserved indefinitely. Unless this is done there is little or no hope of maintaining the herd in its entirety. So far as known the Goodnight herd is not for sale, but a proposition has several times been presented to Congress regarding the reservation of certain public lands in New Mexico for their preservation. Under proper restrictions this plan might result in the perpetuation of the herd for some years. (7) Should the government acquire possession of a considerable number of full-blooded animals, it is possible that the absolute extermination of the species might be long delayed. To avoid danger of destruction by epidemic disease and deterioration by too close inbreeding, the government herd should be divided and kept in at least two widely separated localities. This would admit of interchange of blood when necessary.

UNIVERSITY AND EDUCATIONAL NEWS.

The General Assembly of the State of Iowa has passed a mill tax for the building support of the three educational institutions of Iowa, as follows: State University at Iowa City, one fifth of a mill to run for five years. This will realize $550,000. The Iowa State College of Agriculture and Mechanic Arts at Ames, one fifth of a mill for a similar period, which will realize $550,000. The State Normal School at Cedar Falls, one tenth of a mill for five years, which will realize $225,000. The state educational institutions receive in addition $434,-269 for the biennial period, distributed as follows: State University, $215,000; Iowa State College of Agriculture and Mechanic Arts, $135,000—of this $35,000 is for additional general support annually, and $10,000 annually for the experiment station, $5,000 for live stock, $5,000 to begin the building of a barn and $35,000 to start a main central building; the Iowa State Normal School, $84,269. Other laws passed affecting science and school matters is a compulsory school attendance law; increasing the pages of the report of the Iowa Academy of Science, and paying for illustration in the same and other state papers and reports.

President Raymond has announced that Mr. Andrew Carnegie had given $40,000 to Union College for the completion of Nott Memorial Hall.

The Wilson Memorial Fund for Washington and Lee University has just been completed. The amount is $100,000, and is for the support of the Department of Economics, which was developed through the efforts of President Wm. L. Wilson. For the present the excess of income above the salary of the professor of economics will be allowed to accumulate, until with subsequent gifts it amounts to $25,000, when a memorial building will be erected.

The New Jersey Legislature has appropriated $12,000 for the establishment of a course in ceramics at Rutgers College. The institution has also received a gift of $20,000 from ex-Governor F. M. Vorhees and Mr. Ralph Vorhees.

The Lowell Textile School has received a gift of $21,000 from Miss Charlotte Kitson and Mrs. Emma Stott, daughters of the late Richard Kitson, founder of the Kitson Machine Company. The money is to be devoted to the construction of a spinning building, 275 by 60 feet, adjacent to the group of buildings already under construction, and to be ready for occupancy next September.

Mr. George Westinghouse, of Pittsburg, has made known his intention to present to St. Paul's School, in Concord, N. H., a new building to be used as a physical and chemical laboratory. Plans are now being drawn and a location has been decided upon nearly opposite the new Sheldon library building.

In order that officers of the medical corps of the navy may continue their professional studies, Secretary Long has, upon the recommendation of Surgeon General Rixey, proposed to Secretary Root the establishment of a joint Army and Navy College. That officers may be available for study as well as for duty the secretary has also asked Congress for a slight increase of the medical corps.

Mr. W. W. Astor has given £20,000 to the University of London for the endowment of professorships. This gift is in answer to an appeal by Lord Reay, president of the College, who asked for £700,000 for the endowment of existing chairs and the foundation of new professorships.

By the will of the late Mr. Robert Irvine, of Edinburgh, a chair of bacteriology is endowed in the University of Edinburgh.

Bowdoin College will celebrate its hundredth anniversary at the approaching commencement.

The Rev. Henry Hopkins will be installed as president of Williams College on June 24.

Miss E. E. Carlisle, who has had charge of the work in pedagogy at Wellesley College, has resigned to become one of the supervisors of the Boston schools.

Dr. S. Schlechter, the eminent Talmudic scholar, has accepted the presidency of the Jewish Theological Seminary, and arrived last week in New York to assume the duties of the office.

The Geological and Mineralogical Laboratory at Freiburg has been divided, Professor Steinmann being made director of the Geological Laboratory and Professor Gräff director of the Mineralogical Laboratory.

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, MAY 2, 1902.

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THE AMERICAN PHILOSOPHICAL SOCIETY.

THE PRESIDENT'S ADDRESS.

THE American Philosophical Society has conferred upon me the duty and pleasure of offering to you a hearty welcome to this General Meeting of the Society, and of expressing the gratification felt by all its resident members at the success which has rewarded their effort to assemble in this historic hall as many as possible of our non-resident members and friends from other parts of our country. Though widely separated as regards residence, and in the character of our labors, we are all of us as members warmly interested in the success and renown of our ancient Society. We who happen to live here know, and have always known, that our non-resident but fellow members, however distant they may be, constitute nevertheless as learned and accomplished a body of scholars as could be assembled anywhere. We know this partly from our limited opportunities of personal acquaintance, which we ardently hope may be more frequent hereafter, and we also know it as the world knows it, from their high distinction in science, from their published contributions to the world's knowledge, and as we gratefully acknowledge—from the abundant fruits of their labors sometimes contributed here, and which we take pleasure and pride in considering and discussing and giving to the public in our printed *Transactions* and *Proceedings*.

As is doubtless well known to all here present, our Society is not, and never has been limited to one place of activity, or to the promotion of any particular branch of knowledge in preference to another. Its full corporate title, 'The American Philosophical Society held at Philadelphia for promoting useful knowledge,' has remained unchanged since the merger with it of the American Society in 1768, the last four words having been added on that occasion. Franklin's original circular urging its establishment was dated May 14, 1743 (old style), and was entitled 'A proposal for promoting useful knowledge among the British Plantations in America.' After suggesting the need for such a Society and proposing the name of 'The American Philosophical Society,' simply, it proceeded to recommend Philadelphia as the 'center of the Society,' because it was 'the city nearest to the center of the continent colonies, communicating with all of them northward and southward by post, and with all the islands by sea, and having the advantage of a good growing library.' That circular of 1743 now suggests some curious reflections. Though the adjective *continental* was apparently not yet coined, the text seems to intimate that of all the British possessions in America at that day, the 'islands,' that is the British West India Islands, were of equal or greater importance to Englishmen at home and abroad, than what it called 'the continent colonies,' meaning of course those continental settlements which had then received political charters of partial autonomy, but which have since grown out of comparison with any 'islands,' and by mutual association and union have expanded to a great nation, second to none in the ancient or modern world.

The reasons originally assigned for placing the Society's 'center' at Philadelphia, though then eminently and perhaps exclusively true of that place, seem extremely quaint to us moderns, who have become accustomed to seeing throughout our vast territory hundreds of libraries of greater dimensions and richer endowments than the 'good growing library' of 1743, and from whom the center of population has removed itself a thousand miles or more to what was then the heart of an unpopulated, unvisited and wholly unknown wilderness.

And yet, although the mighty changes of a hundred and sixty years have rendered no longer applicable Franklin's reasons for locating the seat, or as he called it the 'center' of the Society, it is nevertheless from those changes that we derive our chiefest compensation. It is true that we no longer find it necessary to enact as our earliest predecessors recommended, that there 'shall always be at Philadelphia at least seven members, viz., a physician, a botanist, a mathematician, a chemist, a mechanician, a geographer and a general natural philosopher, besides a president, treasurer and secretary.' During its long existence the Society has hitherto been able to enjoy such advantages without the constraint of law. It has been enabled to provide itself with officers—sometimes from an embarrassment of riches, and if our resident scholars should in any future emergency prove unequal to its necessities, we are happy in the assurance that our numerous non-resident members, dwelling in, and illuminating many parts of the world, might be relied on to come to its relief with an aggregate of wisdom and authority not inferior to the resources of the still more venerable Royal Society itself. Though our city remains in the same place and continues to appreciate and maintain the libraries, museums and institutions of our predecessors, it is no longer 'central' as regards any of these things, and has long ceased to be the only, or perhaps even the chief, seat of American learning. But if through the gratifying growth of other places it has sustained a relative decline, in scientific or any other eminence, it is because its methods, models and example have repeated themselves throughout the continent, until there is now scarcely a city that does not contain a center of intelligence and attainment radiating a fructifying influence far beyond its immediate vicinity.

We cannot keep the fact too plainly before us, that the work and influence of our Society were never meant to be local or confined to any one place, whether central or not. It aimed from its first act, to be continental in its influences, to encourage research everywhere as well as in its own vicinity. And if its originally avowed object—'the promotion of knowledge'—has been so successfully prosecuted as to plant younger and fresher centers of learning in every quarter of our country, what more glorious consummation could there be of the designs of our departed founders, and what more magnificent compensation to their successors who still prosecute their studies almost within the shadow of this ancient hall?

The Society desires to give the highest practical expression to its absolutely national character, and to adopt all methods which experience has shown to be most conducive to promoting the objects for which it was founded, and will gladly welcome at this meeting suggestions to that end. It has believed that an important step in that direction will be the holding annually a general meeting of its members from all parts of the country, of which the present meeting is the first. It is probable that such annual general meetings, supplemented by the facilities afforded by our ordinary semi-monthly meetings, will fulfil many requirements of the intellectual activity of our members, while our *Transactions* and *Proceedings,* widely circulated among the scientific societies and workers of the world offer speedy and unexcelled avenues for publication.

During the hundred and sixty years of our existence vast changes have occurred in the population and economic conditions of our country. Besides the radical political changes of 1776—which indeed were accomplished within sound of my voice—there has occurred an increase of population and industry which is quite unique in modern times. A scanty littoral population which for want of adequate land communication, had long clung closely to the seacoast and its estuaries, becoming almost suddenly independent of the highways provided by nature, has expanded itself over a great continent with results undreamed of by the wisest of our ancestors who lived before the age of steam. Already this population has become the largest homogeneous people speaking a single language which now exists as a separate power, and there is no reason to doubt its continued future increase both in numbers and in homogeneity. Nor for that matter need we doubt that before life departs from our planet with the waning sun, but in a remote future, new ethnologists and archeologists and perhaps even anatomists, will arise to dispute our homogeneity and will carefully study our origin, character and social structure, our language, civilization and religion, and the atrophy, exhaustion or catastrophe from which we shall perhaps have perished as a nation.

But it is not my purpose to occupy your time with speculations on past or present material affairs, except so far as they are inseparable from our intellectual history, because all such affairs are subordinate to and dependent upon the progress of mind and knowledge. Of all human agencies it is these alone which have governed—and must always govern human affairs and human progress.

When I remind you that the life and labors of our Society have covered five generations as these are usually estimated, it is pertinent to remark that mere non-comparative figures convey but little definite apprehension to the mind unaccustomed to dealing with large numbers. When one of our justly distinguished astronomical members tells us that a given star is distant so many hundred millions of miles, the figures carry little real information to those of us who are not accustomed like him to consider such enormous numerals. But when he measures to us their equivalent in diameters of the earth's orbit, or proves that its light at known rates of motion must require some centuries to reach us, then we can get some notion of the results that he has reached in traversing the laborious march from hypothesis to demonstration. So, when we reflect that more than one of the sciences now best known had their first crude beginnings and earliest struggles in this hall, we get a more definite idea of the venerable age of our Society and the work that has been done here. If, for example, we turn to human anatomy, where our researches have so remarkably advanced our knowledge, it is true that dissections had been made, and the leading facts of structure, and even of function, ascertained before our Society was born. One might therefore suppose that human osteology at least—the knowledge of those essential and durable organs most prominent in all dissections—was then well known. And yet this Society had been in existence for more than half a century, when new bones and new parts and functions of bones were first discovered and described by one of our members in this room, which excited the interest and induced the correspondence of such famous anatomists as Cuvier, Sömmering and others.

Taking a glance at geology, it is probable that one of the most epochal books ever written prior to the vaster generalizations of Darwin, was that of Sir Charles Lyell. And yet even before the birth of Lyell, when Hutton and the early English geologists were first beginning to be dissatisfied with the Noachian deluge as the only available explanation of the phenomena they noted, fossil remains were examined and described in this hall, and the work of our members had no trivial share in guiding the world to the real solution. Our early geologists—like theirs—found that problematic deluge entirely inadequate to explain even such primitive facts as the existence of marine remains hundreds of miles from any then known ancient or modern seacoast, or the massive deposits of calcareous rocks containing marine shells and crustacea high up on mountain sides remote from the sea, or of the ripple marks, foot tracks and actual remains found embedded deeply in solid sandstone strata. Such early doubts and difficulties found appropriate and congenial place in the *Proceedings* of this Society, and Mr. Curtis in his recent life of Jefferson tells an amusing story in that connection.

The great statesman was at the same time president of the United States and of this Society, and sometimes professed to doubt which of those honors he valued most. He had covered the floor of a large room in the White House with miscellaneous fossil bones sent to him from Virginia, and had formed theories concerning them which were so unsatisfactory to himself that he begged one of his friends—a distinguished paleontologist of this Society—to come to Washington and examine them. A carriage journey from Philadelphia to Washington before the days of steam was no trifling ordeal for a middle-aged philosopher, yet a room full of new fossils proved irresistible, the journey was performed, and the remains at once identified as those of *Elephas* and *Mastodon*, much to the disadvantage of Mr. Jefferson's theories.

The important science of electricity, of which during the past century we have but entered the threshold, as is well known, had its birth in this Society, and one might say in this room. It was here that Franklin first contrived his experiments, and by artificial means drew electricity from the clouds. It was here that he designed and constructed the first machine for obtaining it from terrestrial objects. It was here that it was constantly exhibited, studied and discussed, and since that day the Society has never lacked the presence and labors of a competent and distinguished body of its students and investigators. It is no fault of theirs that this great science, though studied by all the world for a century, has not yet been mastered. Notwithstanding our actual production or segregation of electricity on an enormous scale, and the astonishing practical uses to which it has been harnessed, we still know but little of its nature and origin, and almost nothing of the character and extent of its practical usefulness in the grand scheme of Nature. We have reason to believe that it pervades the cosmic universe, and suspect it of performing necessary functions not yet understood both in microscopic and cosmical economy.

And now after this brief glance at our far-reaching past and still briefer mention of some of the branches of knowledge which had here their birth or infancy, what can be said of the future? Here we may at once admit that the mysterious realms of ignorance still remain far more extensive than those to which the light of knowledge has been brought. Even the work that has been done invariably reveals unexpected new work remaining to be done. We have catalogued hundreds of sciences whose names were unknown but a generation since. But though we have named and neatly labelled them and readily perceive their intimate relationship with their cousins both new and old, how much do we positively know of any of them? If we recur again to human anatomy—one of the oldest and best known of all, we find the world has been pondering it since the time of Aristotle, but all that it had learned of the prominent organs, their morphology, relations and functions, has been reduced to minimum relative importance, by the revelations through the microscope of the innumerable secrets yet to be learned. We now find how little we really know of tissues, cells, corpuscles, and above all of the still mysterious nervous system, the seat of all intelligence. Of the numerous cerebral nervous centers we have localized a few, but know little of the vast majority. We scarcely know what office or power to attribute to the 'convolutions' or what to withhold from them, and although we suspect much, yet in fact we know so little about them that their principal use to anatomists at the present time seems to be as receivers of hypothetical attributes of function which could not safely be loaded on anything else. Even if we confine our researches to the entire organ, can the anatomist tell us with certainty the structure and proportions of a normal brain, or can he define brainal normality itself, and inform us what it is and how it may be known?

In fact after so many centuries of study, we may go even farther and enquire whether we are yet able to find any precise and intelligible definition for life itself. We describe it as 'conscious,' and 'reproductive.' But we now know that animal life exists which is apparently not conscious and is certainly not reproductive. And yet though such life is neither conscious nor intelligent, it is seen to possess some quality, unknown and as yet incomprehensible to us, which is a fair equivalent for intelligence. In short it may even yet be safely said that if hundreds of volumes are required to contain our knowledge thousands would be necessary to catalogue our ignorances.

There remains then plenty of work to be done. No one who loves knowledge and is willing to work need ever want object or occupation. Nature's own operations have no more predominant characteristic than their extreme slowness, and it is not surprising that our most fruitful researches have in that respect imitated her deliberate and tentative evolutions. But it is encouraging to remember that whatever moves ceaselessly onward, losing no forward step and accumulating all its gains, must in time reach the goal. Though the masses of ignorance are still large and dark before us, knowledge does steadily accumulate on all our traversed paths. Time is long, and if we cultivate the same untiring patience which Nature has uniformly practiced in her gradual development of all things organic and inorganic, it is but a mathematical axiom that a day must come when we shall overtake her at her work—catch her, as it were, bare armed in her secret workshops, and claim undisputed heirship in all her works.

The grand results of that full and perfect knowledge which, though not for us as individuals, must come to our posterity, no mind now living can grasp or estimate. Recurring for illustration to the oft-quoted and somewhat ill-treated science of anatomy, when that day of complete and perfect knowledge shall arrive, when, for instance, our successors shall have traced out all its mysteries, localized every function, and identified every brain center and working cell, why should the future training of the individual be limited to the tedious imitative methods to which we are now confined? When with perfect knowledge we shall know how to treat all the centers of thought and will with wise discrimination, stimulating the good and repressing the bad, why should it not be possible to cultivate by unerring means intellect and even morals, to produce a great general or an honest statesman when he is most needed, to constitute a new society as superior to ours as we are to our humblest ancestors of primeval seas?

Let us not too hastily pronounce the sentence of extravagance against such hopes and speculations. To the generations of Galileo and Newton, of Laplace and Darwin, the first glimmerings of truth reached by those great leaders were equally startling. Yet in the lapse of time they have become established facts, on which the world of science plants itself with confidence as it moves forward to new conquests. Rather let us by every individual and associate effort preserve in full flower and fruit the vigor of our ancient Society as a center of continued labor. Let us encourage and stimulate each other in pressing on toward the attainment of complete knowledge. Because it is that, and that alone, which we cannot but observe, is destined to move onward and upward the world of life, and to maintain our human race in the primacy which it by no means always possessed, but is now claiming with no empty boasts.

Isaac J. Wistar.

THE GENERAL MEETING.

The first general meeting of the American Philosophical Society was held in Philadelphia on April 3, 4 and 5, 1902. Founded by Benjamin Franklin in 1743 the Society is the oldest scientific organization in America devoted to the advancement of general knowledge; and although it has always numbered among its members many of the most distinguished scholars of this and foreign lands, no concerted attempt had heretofore been made to bring together the general membership of the Society for the presentation and discussion of scientific papers. The success of this first general meeting has been so gratifying that it is almost certain that it will not be the last of its kind. About one hundred and twenty members of the Society were in attendance upon the meetings, of whom upwards of fifty came from places more or less distant from Philadelphia.

At the annual election held on the second day of the meeting the following persons were elected to membership in the Society:

RESIDENTS OF THE UNITED STATES.

John A. Brashear, Sc.D., Allegheny, Pa.

Acting Director of the Allegheny Observatory; Fellow of Royal Astronomical Society of Great Britain; Member of British Astronomical Association; of Société Astronomique de France, etc.; maker of astronomical and physical instruments of world-wide repute.

Andrew Carnegie, LL.D., New York.

Lord Rector of the University of St. Andrew; munificent contributor to the promotion of science, learning and the useful arts; founder and endower of the Carnegie Institution, at Washington, for the promotion of original research.

Professor William B. Clark, Baltimore.

Professor of Geology, Johns Hopkins University; State Geologist of Maryland; Associate Editor of the *Journal of Geology;* author of numerous papers in publications of United States Geological Survey and Maryland Geological Survey and in scientific journals.

Professor Hermann Collitz, Ph.D., Bryn Mawr.

Professor of Comparative Philology and German at Bryn Mawr College; author of 'Sammlung der Griechischen Dialektinschriften,' and of many valuable philological contributions.

Grove K. Gilbert, Washington.

Past-President of the American Association for Advancement of Science; Member of National Academy of Sciences; Geologist in United States Geological Survey since 1879; in Ohio Survey, 1868–70; in Wheeler Survey, 1871–4; in Powell Survey, 1875–9. Author of 'Geology of the Henry Mountains' and of numerous reports and articles in publications of the United States Geological Survey.

President Arthur Twining Hadley, New Haven.

President of Yale University; of American Economic Association; Author of 'Railroad Transportation, its History and Laws,' 1885; 'Economics—An Account of the Relations between Private Property and Public Welfare,' 1876, etc.

Professor George E. Hale, Williams Bay, Wis.

Professor of Astrophysics and Director of the Yerkes Observatory, University of Chicago; author of many valuable papers on the sun, stellar spectroscopy, etc.

Professor Paul Haupt, Baltimore.

Professor of Semitic Languages in Johns Hopkins University; editor of the 'Polychrome Bible'; author of 'Sumarisch-Akkadische Keilschrifttexte,' 'Sumarische Familiengesetze,' 'die Akkadische Sprache,' etc., and of numerous papers on Biblical and Assyrian philology, history and archeology.

C. Hart Merriam, Washington.

Chief of the United States Biological Survey, Department of Agriculture; one of the most eminent of America mammalogists; author of several works and numerous papers on zoological and botanical subjects.

Professor Albert Abraham Michelson, Sc.D. (Cantab.), Chicago.

Head Professor of Physics in University of Chicago; Member of National Academy of Sciences; Fellow of Royal Astronomical Society; author of numerous valuable papers chiefly on researches in light.

Professor Theodore William Richards, Cambridge, Mass.

Professor of Chemistry in Harvard University; Member of National Academy of Sciences. Author of numerous papers concerning atomic weights and physical chemistry.

Professor Felix E. Schelling, Ph.D., Philadelphia.

Professor of History and English Literature in University of Pennsylvania; author of 'English Chronicle Plays'; editor of 'Book of Elizabethan Lyrics'; 'A Book of Seventeenth Century Lyrics'; etc.

Professor Robert Henry Thurston, Ithaca.

Professor of Mechanical Engineering, Stevens' Institute, 1871–85; Director of Sibley College, Cornell University, since 1885; first President of American Society of Mechanical Engineers; inventor of various valuable mechanical devices; author of about 20 volumes and some 300 scientific papers.

Benjamin Chew Tilghman, Philadelphia.

Manufacturing chemist and student of chemistry and physics; author of a monograph (as yet unpublished) on the chemical changes undergone by bones in passing from the living to the fossil condition.

Professor Robert S. Woodward, New York.

Professor of Mechanics in Columbia University; mathematician and astronomer of recognized eminence; Past-President of the American Association for Advancement of Science; President of American Mathematical Society, 1898–1900; Member of the National Academy of Sciences; author of numerous scientific papers on geodetic and astronomical topics.

FOREIGN RESIDENTS.

Antoine-Henri Becquerel, Paris, France.

Member of the Institut de France—Académie des Sciences; the third in descent of the French physicists of the name who have made themselves famous by their researches in science; his work has been chiefly in optics and magneto-optics; he discovered the uranium emanations, now called by his name, which led to the discovery of radium.

Jean-Gaston Darboux, Paris, France.

Perpetual Secretary of the Académie des Sciences—Section of Mathematics; eminent mathematician and author of numerous valuable papers on that subject.

Sir Michael Foster, F.R.S., D.C.L., Cambridge, Eng.

Secretary of the Royal Society; Professor of Physiology at Cambridge; Honorary Perpetual President of the International Congress of Physiologists; Chairman of the International Council in charge of the International Catalogue of Scientific Literature; President of British Association for Advancement of Science, 1899; author of 'Text-Book of Physiology,' and of other works; Joint-Editor of 'Scientific Memoirs of Thomas H. Huxley.'

Professor G. Johnstone Stoney, F.R.S., London, Eng.

Graduate of the University of Dublin and Fellow of Trinity College; formerly Astronomical Assistant to the Earl of Rosse, at Parsonstown, and subsequently Professor of Natural Philosophy in Queen's University; his papers upon the 'Physical Constitution of the Sun and Stars,' on the 'Internal Motion of Gases,' on 'Spectroscopy and Microscopy' have attracted universal attention.

Professor Silvanus P. Thompson, F.R.S., London, Eng.

Principal and Professor of Physics in City and Guilds Technical College, Finsbury; a well-known investigator in physics and an authority on electrical subjects; author of sundry technical works on electricity, and of 'Lectures on Light, Visible and Invisible.'

The sessions of the general meeting began on Thursday morning, April 5, in the historic hall of the Society in Independence Square, with an address of welcome by the president of the Society, General Isaac J. Wistar, in which he pointed out the broad and liberal character of the Society as indicated by the plans of its founder and the subsequent history of the Society, and also the important part which the Society has taken in the 'promotion of useful knowledge.' This address, which will be published in full elsewhere, was followed by the presentation of the following scientific papers, most of which will appear in the *Proceedings* and *Transactions* of the Society:

Professor John B. Hatcher, of Pittsburgh, in a paper on the 'Origin of the Oligocene and Miocene Deposits of the Great Plains,' called attention to the great deposits of bones at various localities in the White River beds. He described them as literally covering the ground in places where they have weathered out over areas frequently of more than an acre in extent. It is not only difficult, but Professor Hatcher thinks impossible, to account for these accumulations of bones of terrestrial animals at the bottom and in the very middle of a great lake. Since the surrounding clays are usually almost destitute of bones, it is difficult to understand how the dead carcasses of so many animals were driven or drawn as by a magnet to so limited an area. Accepting the other theory, however, we have seen how, during the rainy season, the deer, tapirs and other animals are driven to the islands over the flood plains of the great South American rivers. Since in exceptionally high freshets the lower of these islands become destroyed, it is not difficult to understand how great numbers of these animals must annually perish, and indeed it is a well-known fact that frequently great numbers of them are caught on low islands and, driven by the rising waters to more limited confines, they are finally all drowned when the island becomes entirely submerged. To such or similar conditions the great deposits of bones in the Oligocene and Miocene deposits of the West may owe their origin.

These facts, together with those brought forward by Dr. Matthew in his article 'Is the White River Tertiary an Æolian Formation' (*Am. Naturalist*, May, 1899), have driven Professor Hatcher, contrary to his earlier opinion, to reject the theory of a great lake and accept that of small lakes, flood-plains, river channels and higher grass-covered pampas as the conditions prevailing over this region in Oligocene and Miocene times.

MR. EARL DOUGLASS, of Princeton, in a communication on 'The Upper Cretaceous and Lower Tertiary Section of Central Montana,' pointed out that the finely exposed section of Cretaceous and Lower Tertiary rocks near the Musselshell River in Montana has been considerably affected by the disturbances that produced the mountains a little farther to the westward, so that erosion has exposed the different formations from what is apparently the Jurassic to the Torrejon. He maintained, (1) that there are beds below the Fort Pierre, which have Laramie flora and fauna; (2) that the Livingston, Arapahoe and Denver beds correspond in age with the upper portions of what has been called Laramie; and (3) that the Fort Union beds are of the same age as the Torrejon in New Mexico.

PROFESSOR W. B. SCOTT, of Princeton, in a paper on 'South American Mammals,' confined his remarks to the Edentata of the Santa Cruz (Miocene) beds of Patagonia. Very curious is the absence from these beds of the existing families of the ant-eaters and the true or arboreal sloths, while armadillos, glyptodonts and ground-sloths are most abundantly represented. The armadillos are nearly all of aberrant type and very peculiar in some respects; only one species seems to be ancestral to a species of modern times.

The glyptodonts are very small and in remarkable contrast to the giant forms of the Pleistocene.

The ground-sloths are relatively small, as compared with the huge representatives of this group which in Pleistocene times spread over nearly the whole of North and South America. In the Santa Cruz beds are found the probable ancestors of nearly all the Pleistocene genera. Of especial interest on this occasion is the newly discovered genus which seems to be the ancestor of *Megalonyx*. The latter was first discovered by President Thomas Jefferson and described in an early volume of the *Transactions* of this Society.

SAMUEL N. RHOADES, of Audubon, N. J., in a paper on the 'Mammals of Pennsylvania and New Jersey,' said that Pennsylvania and New Jersey, on account of their geographic position and the consequent variety of the faunal environments afforded by the two extremes of the elevated Alleghanian summits and the sandy maritime plains of the southeastern coast line, present a relatively large and varied list of land and sea mammalia. These number in existing native species and races ninety-five, of which seventy-seven are terrestrial or amphibious, and eighteen are aquatic.

The extinct mammalian fauna of the two states is remarkably large, exceeding greatly that of the entire remainder of the United States east of the Mississippi River. Of extinct terrestrial mammalia there have been described, mainly from the limestone bone caves and fissures of the Pleistocene horizon in the lower Delaware Valley, ninety-one species. These include such tropical genera as the giant sloth, rhinoceros, tapir, elephant, manatee and saber-toothed tiger, as well as arctic forms now only existent in Canadian regions, such as the reindeer, moose, musk ox and walrus. From the marl beds of New Jersey nine species of whales, referable with one exception to the tropical shark-toothed family now existing in the Indian Ocean, have been described.

Comparing the two lists, the remarkable fact is shown that in Pennsylvania and New Jersey the list of extinct species of mammals known to us equals, if not exceeds, that of the existing species. In contrast to this New York in Miller's recent list only boasts of five species of known extinct mammalian species.

The effect of deforestation by axe and fire, and its consequent radical alteration of climatic conditions even in the most inaccessible parts of the Alleghanian wilderness at the present day, has done much more to alter the faunal status than all other destructive agencies combined. In consequence many of the least known of the smaller mammalia approach extinction. Of the larger, the native wapiti, bison, beaver, cougar, wolf and wolverine, some of which lingered far into the last century in Pennsylvania are now exterminated.

Dr. Frederick W. True, of Washington, in a communication on 'The Identity of the Whalebone Whales of the Western North Atlantic,' summarized the results of an extensive investigation of the whalebone whales of the Atlantic coast of North America carried on under the U. S. National Museum, the principal object being to ascertain whether the species which occur in American waters are the same as those known to frequent the coast of Europe, and thus to provide a more trustworthy basis for the study of the geographical distribution of these animals. The American species were found to be the same as those of Europe, but the European finback whale known as Rudolph's Rorqual, *Balænoptera borealis* Lesson, has not been found in American waters. The species occurring on the east coast of North America are as follows:

Greenland whale or Arctic right whale, *Balæna mysticetus* (L.).

Black whale, or the right whale of the Temperate North Atlantic, *Balæna glacialis* (Bonnaterre).

Humpback, *Megaptera nodosa* (Bonnaterre).

Common finback, *Balænoptera physalus* (L.).

Sulphurbottom, *Balænoptera musculus* (L.).

Little piked whale, or lesser finback, *Balænoptera acutorostrata* (Lac.).

AFTERNOON SESSION.

Professor H. von Ihering, of São Paulo, Brazil, in a paper on the 'Molluscan Fauna of the Patagonian Formation,' which was presented by Professor W. B. Scott, described two of the most striking of the many new species contained in the large collection made under his direction.

Professor Edward S. Morse, of Salem, Mass., in a 'Comparison between the Ancient and Recent Molluscan Fauna of New England,' said that the results of observations and measurements of the species of shells found in the shell heaps of New England, in comparison with the shells of the same species found living to-day in close proximity to the deposits and presumably their descendants show in every case a change in the proportionate diameters. As an illustration, the common clam, *Mya arenaria,* found in the shell heaps has a greater height in proportion to its length than that of the recent forms. This index is higher north of Cape Cod, both in the ancient and recent. The same differences are found in Japan and in England. The index is very much higher in the glacial deposits. For this and other reasons the change in the index is correlated with temperature.

It is furthermore pointed out that related forms in Japan and New England had changed in precisely the same manner. Full details with tables of measurements will be given in the memoir on the subject.

PROFESSOR ARNOLD E. ORTMANN, of Princeton, in a paper on the 'Distribution of Fresh Water Decapods and its Bearing upon Ancient Geography,' said that the present and former distribution of these animals suggested the following land connections in former times:

1. Northeastern Asia with northwestern America, across Bering Sea.
2. East Asia (Sinic Continent) with Australia, over the Malaysian islands.
3. South Asia and Africa, by way of Madagascar.
4. New Zealand with Australia, by way of New Caledonia and New Guinea.
5. Australia with Antarctica, and Antarctica with South America (Archiplata).
6. The Greater Antilles with Central America.
7. Africa with South America (Archibrazilia).

PROFESSOR W. M. DAVIS, of Cambridge, in a paper on 'Systematic Geography,' said that the accumulation of an ever-increasing store of facts under the broad subject of geography makes it desirable to establish a classification with respect to which the facts may be arranged, not only for the convenience of putting them away in good order and of readily finding them again when wanted, but even more for the sake of the better understanding that comes from association and correlation. Geographical classification may be by kinds or by places, systematic or regional; but the first should precede the second. The first provides a scheme whereby all similar items, whatever their place of occurrence, may be brought together under a single category; the second describes all the items of a certain region as examples of known categories, and presents them in an order that expresses their systematic relationships. There is to-day no precise agreement as to the total content of geography, much less as to the subdivision and systematic arrangement of its parts; but if the study of the earth in relation to its inhabitants be taken as a sufficient definition of the subject, its prime divisions must be the physical environment of organisms and the responses of the organisms to their environment. Each of these divisions is then to be subdivided into many categories, and each category is to be rationally described, to be illustrated by typical examples, and to be traced through its relationship to the categories of the other prime divisions of the subject. The innumerable relationships thus disclosed constitute the subject of geography proper, and it is as an aid to their systematic treatment that the proposed classification of the subject as a whole is undertaken.

MR. HENRY G. BRYANT, of Philadelphia, in his paper entitled 'Drift Casks in the Arctic Ocean,' gave the present status of an experiment worked up by Admiral George W. Melville, U. S. N., and himself, which aimed to test the speed and direction of Arctic currents by means of a series of drift casks set adrift in the Arctic Sea north of Alaska. He called attention to the fact that the scheme was the outcome of the Nansen Meeting of the American Philosophical Society held in 1897, on which occasion Admiral Melville called attention to the feasibility of a plan to ascertain the speed of ocean currents in the circumpolar regions by setting adrift a series of especially constructed, spindle-shaped casks in the waters north of Bering Strait and in other parts of the Arctic Ocean.

This proposed method of studying Arctic currents without endangering human life was brought to the attention of the Geographical Society of Philadelphia and that body determined to undertake the project. Fifty casks of special shape, to escape crushing by ice pressure and covered with a coating of black water-proofing material were made in San Francisco. Messages printed on linoleum paper by a permanent blue-print process, which renders them impervious to salt water, were provided. These messages were printed in the English, Norwegian, German and French languages and embodied the following particulars: (*a*) Name of vessel and master assisting in the distribution, date, number of cask and latitude and longitude of point where it was set adrift; (*b*) direction as to filling in record and sealing up tube; (*c*) blank space for insertion of name of finder, date and locality where cask was picked up; (*d*) clause requesting finder to notify the nearest U. S. Consul or to send direct to the Geographical Society of Philadelphia. Accompanying each consignment of casks was a set of printed instructions to masters of vessels engaged in their distribution.

In the hazardous work of distributing the casks assistance was rendered by the U. S. Revenue Cutter *Bear* and the vessels of the whaling fleet sailing from San Francisco. Mr. Bryant stated that reports of the accomplishment of the preliminary work have come in rather slowly, owing to the length of the whaling voyages. The work of distribution had begun in 1899 and reports were still coming in from the whaling captains. To date, thirty-five casks had been launched in the far North and fifteen remained yet to be heard from.

It has been known for years that no appreciable amount of water from the polar ocean escaped through the narrow, shallow outlet of Bering Strait, while the knowledge gained from the drift of the *Jeannette* and *Fram* points to the existence of a well-defined drift across the circumpolar area to the shores of Franz Joseph Land, Spitzbergen and East Greenland. The presence of quantities of Siberian driftwood in the localities named can be explained by no other intelligent hypothesis, while it is well known that Dr. Nansen based the theory of his voyage primarily on the finding of the *Jeannette* relics on the west coast of Greenland, three years after the crushing of that vessel in the sea northeast of the New Siberian Islands.

From the nature of the case, it is difficult to prophesy the time that will be required to complete the drift, but it is safe to assume that from three to five years will be required by the casks to make the journey across the polar basin.

Mr. Joseph Wharton, of Philadelphia, speaking of 'The Magnetic Properties of Nickel,' said that this metal is capable of being made permanently magnetic. He made a horseshoe magnet and ship compasses of nickel for the Centennial Exposition of 1876, and sent compasses to the American, British, French and Russian governments for experiment on shipboard. The United States and English officials paid no attention to the matter, but the other countries named made official investigations, indicating, among other things, that pure nickel shows a very considerable permanent magnetism—about one half as much as hardened steel.

In the evening session, President HENRY S. PRITCHETT, of the Massachusetts Institute of Technology, spoke on 'The Relation of the American University to Science,' and President DANIEL C. GILMAN, of the Carnegie Institution, on 'The Advancement of Knowledge by the Aid of the Carnegie Institution.' These addresses were followed by a public reception at the Museum of Science and Art, given in honor of the members of the Society by the Department of Archeology of the University of Pennsylvania.

FRIDAY MORNING SESSION.

PROFESSOR T. J. J. SEE, of Washington, in a 'Historical Investigation of the Supposed Changes in the Color of Sirius since the Epoch of the Greeks and Romans,' pointed out that the highest authorities of antiquity attributed to Sirius a ruddy color, and that there is no authority who says that the star was white, and that it has become white since the time of the Roman emperors—perhaps since the end of the fourth century. The star may have changed color very suddenly, or its redness may have gradually faded with the centuries and disappeared slowly like the ancient civilization. In modern times the star has always appeared white, and there is therefore no suspicion that the color changes periodically. The redness of a star's light depends, without doubt, mainly upon selective absorption; accordingly, the natural explanation of this change of color would seem to be a change in its atmosphere.

PROFESSOR ERNEST W. BROWN, of Haverford, Pa., in a paper on 'Recent Progress in the Lunar Theory,' gave a general account of the lines along which investigation has proceeded during the last thirty years. The work of Dr. G. W. Hill on periodic orbits was the starting point of the investigation undertaken by M. Poincaré. The investigations of the latter on divergent series were also referred to. The second part of the paper contained an account of the progress made towards verifying the law of the inverse square. The writer also gave an account in some further remarks of the progress made in the theory which he is now working out. He pointed out in what way it might settle some outstanding difficulties.

PROFESSOR M. B. SNYDER, of Philadelphia, in a paper 'On a new Method of Transiting Stars,' described a method of driving the ordinary micrometer screw of the transit instrument by means of a small electric motor to the speed pertaining to any given declination, at the same time that the observer by a secondary adjustment of the position of the wire secures and maintains bisection of the star, and an automatic record of given positions of the screw is made on a chronograph. The Repsold method of alternately twirling the screw of a specially constructed micrometer was held to be radically defective in important particulars. Various devices for accomplishing the electrical method of driving and of regulating the motion of the screw of the transit micrometer, as well as the actual arrangement in use at the Philadelphia Observatory, called for brevity a 'transiter,' were described. The transiter seemed to furnish all the necessary facilities of motion and of recording, and not only permitted elimination of all errors excepting that of bisection, but for the first time allowed of the direct determination of absolute personal equation upon the stars themselves at all transits where this might be desired.

MR. PERCIVAL LOWELL, of Flagstaff, Ariz., spoke on 'The Evolution of Martian Topography.' He said that one of the great causes of misapprehension and contradictions in former observations of Mars is that the planet looks differently in winter and summer. The dark patches were called seas, but it has been found that there are no seas on Mars. There are no large bodies of water, and the question is: Are there even small ones? The surface is vastly different from that of the earth, in that it is apparently all land, but there is a strange similarity in the air currents.

He described the investigations of Schiaparelli and others and deduced evidence that the so-called canals are vegetation.

Mars is passing, like the earth and the moon, through a process of drying up. It is not as far advanced as the moon, where there is no moisture or atmosphere, but it is farther advanced than we are.

PROFESSOR CHAS. L. DOOLITTLE, of Philadelphia, presented a paper on 'Results of Observations with the Zenith Telescope at the Sayre Observatory.' In 1876 was begun at the observatory erected by Robert H. Sayre at South Bethlehem, Pa., a series of 'Latitude Observations' which was continued with considerable interruptions until August 19, 1895. The final results of the latter part of this series, from January 19, 1894, till the close, were published in full about one year ago.

The present communication, which concerns the earlier portion of this work, comprised three sections or subdivisions.

1. Investigation of the right ascensions and declinations of the stars employed in the latitude work—254 in all.

2. Results of latitude observation from 1876 to 1891—2,623 determinations.

3. Results of observations from October 10, 1892, to December 27, 1893—2,900 determinations.

In section 2 the latitude determinations discussed are distributed very unequally through the years 1876, '77, '78, '85, '86, '88, '89 and '90. With the exception of those of 1889–90, they are not well adapted to an investigation of the periodic changes of the latitude.

The investigation of the constant of aberrations was contemplated in planning the work of 1889–90 and that of 1892–93, though it was at that time regarded as a kind of by-product. Each observation furnishes one equation for this purpose. The 2,900 equations of the latter series were combined by a process of 'bunching' to form 190 separate equations, which were solved in the usual way, giving for the aberration constant the final value

$$20.''551 \pm .009.$$

A peculiar feature of the latitude values is a progressive diminution of the mean value.

Thus we have the following mean results:

1876–78 Latitude	=40°	36′	23.81″
1889–90	40°	36′	23.41″
1892–93	40°	36′	23.11″

No satisfactory explanation of this apparent diminution has been found.

PROFESSOR JOHN TROWBRIDGE, of Cambridge, presented an interesting paper on the 'Spectra of Gases at High Temperature,' which was illustrated by a series of lantern slides. He called attention to his discovery of dark lines in the spectra of gases not due to absorption, which do not change the silver salt and which give therefore bright lines on the negative. This shows that there are rates of vibration to which the photographic plate does not respond. This discovery leads us to believe that the solar spectrum is probably far more complex even than we have supposed.

AFTERNOON SESSION.

PROFESSOR A. STANLEY MACKENZIE, of Bryn Mawr, presented a paper, entitled, 'On Some Equations Pertaining to the Propagation of Heat in an Infinite Medium,' in which attention was called to the necessity of trying to interpret in terms of physical conceptions all the mathematical operations used in the analytical treatment of physical problems. The inherent physical meaning of each step in the treatment should be made evident, and the general nature of the result of each step should be capable of prediction; this may not always be possible, but it is rather more common than not, to avoid such interpretations. The paper dealt with these points as illustrated in the study of heat conduction (or in cabling), and pointed out the importance of that subject for its pedagogical value in mathematical physics. Beginning with the solution for the periodic distribution of temperature about a point, the solutions for other problems were built up, each step in the analysis being first discussed as to its physical interpretation, and the relationships of the various solutions brought out. In this way was developed the meaning of many of the common operations involved, the possibility of their being solutions, and finally the interpretation of a Fourier's integral. Among other things, careful drawings were exhibited of the curves for temperature and current for the more important equations.

PROFESSOR M. I. PUPIN, of Columbia University, New York, in a paper on 'The Law of Magnetic Hysteresis,' presented an account of a mathematical and experimental research upon the magnetic properties of iron which resulted in the discovery of a new law in magnetism. This law can be stated as follows:

"The heat generated per unit volume of iron during a cycle of magnetization is proportional to the cube of magnetic intensity."

This law holds true within the first of the three well-known intervals of magnetization. It was discovered by determining accurately the resistance of the magnetizing helix, employing vibratory magnetizing forces of about 1,000 periods per second, and then separating the various components of this resistance by means of mathematical analysis.

This investigation is an extension of the researches of Professor Ewing of Cambridge University, England, and of Lord Rayleigh, employing a new and very much more sensitive method. Its results have a very important practical bearing in the manufacture of inductance coils. From its purely scientific aspect the new law derives its principal interest from the fact that it will materially assist in the formulation of the physical theory of magnetism.

PROFESSOR W. K. BROOKS, of Baltimore, presented a one-minute paper on the subject 'Is Scientific Naturalism Fatalism?' It is impossible to fairly report this paper, already admirably condensed, without presenting it in its entirety. It may be said, however, that, basing his opinion on well-known views of Hume and Berkeley, the author maintained that certainty in the natural world does not imply necessity in the agent.

Professor Brooks also presented a paper, illustrated by drawings and models, on '*Dichotoma,* a New Genus of Hydroid Jelly-fish,' found in the Bahamas, which shows many resemblances to a fossil form described by Walcott from the Lower Cambrian.

PROFESSOR HENRY KRAEMER, of Philadelphia, in a paper 'On the Continuity of Protoplasm,' which was illustrated by lantern slides, said that a starch grain consists of alternate layers of colloidal and crystalloidal substances, and that the colloidal layers are the ones which take up the various aniline dyes, as gentian violet, eosin, safranin, etc. The various clefts and fissures produced in the grains behave toward staining reagents much like the colloidal layers, and they are probably the tracts or channels through which liquids are distributed throughout the grain. The author has observed that by the use of various swelling reagents a similar layering is produced in the walls of endosperm and stone cells and that the structure is physically quite similar to, although chemically different from, that of the starch grain.

In continuing these observations on the cell wall, using staining agents in connection with swelling substances, including sulphuric acid, the author finds a close similarity in the appearance produced in the thick-walled endosperm cells in the date, vegetable ivory and nux vomica, and is inclined to consider that the appearance produced in the walls of these and other cells, which has given rise to the widespread conclusion that it indicates a continuity of protoplasm, has a close relation to the colloidal layers and clefts in the starch grain which take up staining reagents. Furthermore, the protoplasm in the cells of vegetable ivory is frequently stained an entirely different color from that of the so-called threads of protoplasm. In nux vomica the threads are interrupted and in vegetable ivory they are peculiarly curved, indicating an alteration of the cell wall, which condition is very pronounced in some of the thinner sections.

Professor Edwin G. Conklin, of Philadelphia, presented, with lantern slide illustrations, a brief synopsis of a paper on the 'Embryology of a Brachiopod, *Terebratulina septentrionalis*.' The early development of this animal is unlike that of annelids and mollusks, though the larvæ belong to the Trochophore type. The larvæ of this brachiopod closely resemble those of *Phoronis* and show certain likenesses to the Polyzoa. All three of these groups should be classed together in a phylum distinct from the Annelida, Mollusca or Chætonatha.

Professor Thos. H. Montgomery, Jr., of Philadelphia, presented in a paper on 'The Relationship of the Gordiacea,' a brief abstract of an anatomical memoir on the genus *Paragordius*. The conclusion reached from a study of the adult structure is that the Gordiacea are neither Annelida nor Nematoda, but in most points of structure appear to represent a phylum distinct from both of these.

Dr. M. Louise Nichols, of Philadelphia (introduced by Professor Conklin), presented a brief synopsis of a paper on the 'Spermatogenesis of *Oniscus asellus*, with especial reference to the History of the Chromatin.' The first of the two maturation divisions in this animal is reducing. The spermatids become associated in groups to form sperm colonies, each of which is flagellate at its anterior extremity.

Dr. Cyrus Adler, of Washington, presented a communication on the plans and purposes of the 'International Catalogue of Scientific Literature,' and exhibited advanced sheets of one of the volumes now being published.

SATURDAY, APRIL 5.

Professor Lindley M. Keasbey, of Bryn Mawr, in a paper entitled 'A Classification of Economies,' defined an economy as a system of activities whereby the potential utilities inherent in the environment are, through utilization, converted into actual utilities. In working out a classification, economies, he said, can be distinguished from each other in two ways: Subjectively, according to the incentive leading to utilization, and objectively, according to the means employed in the process. Applying this canon of distinction, we can distinguish between the *automatic economy* characteristic of plant life, the *instinctive economy* characteristic of animal life, and the *rational economy* characteristic of human life. The course of human development also exhibits three characteristic types of economies: First the *acquisitive economy*, where the motive making for utilization is the acquisition of use values, and the means employed in the process consist of artificial implements that can be worked with the hand. Second, the *proprietary economy,* where the motive is to add to one's possessions or acquire proprietary values, and the means employed in the process consist of agricultural capital, *e. g.,* domesticated herds and cultivated fields. Third, the *commercial economy,* where the motive is the acquisition of exchange values, and the means employed in the process consist of industrial capital, *e. g.,* buildings, shops, ships, machines, etc.

For each of these three types of economies there is a corresponding organization of industry. The organization adapted to the acquisitive economy is cooperative; that adapted to the proprietary economy is coercive; and that adapted to the commercial economy is competitive.

Having established the three fundamental types of economies, the classification may be carried further by taking the several processes of production and the several systems of distribution and exchange into account.

DR. SIMON FLEXNER, of Philadelphia, reported upon some 'Experiments in Cytolysis.' There has been great activity, he said, in the study of the conditions under which tissue and blood cells undergo solution. For the blood cells it has been demonstrated that various agents—chemical, physical and biological—bring about solution—the so-called hæmolysis. The first two agencies act by disturbing osmosis within the cells; biological solution —that produced by foreign blood sera—is produced through a fermentative action (Ehrlich) in which two sets of substances are required. The substances are denominated intermediary body (receptor) and complement, and are normally present in active sera. Should the intermediary body (receptor) be absent, it can be produced by the treatment of animals with blood cells in a manner analogous to the immunization to bacteria. Similar intermediary bodies capable of uniting with appropriate complements can be produced for most or all body cells. In that they are destructive for the specific cells through which they have been produced, they are termed 'cytotoxins.' The most active are the heterocytotoxins, produced in alien animals; but less active isocytotoxins are known and in a few instances autocytotoxins for blood cells have been produced. Hitherto the study of the histological changes produced by cytotoxins has been little pursued. The author has prepared cytotoxins for lymphatic gland cells and injected the product into animals of the class from which they were prepared, with the result of causing definite histological changes in the corresponding tissue. The changes consist of necrosis and multiplication of the cells of the germinal centers, giving rise to appearances indistinguishable from those produced by well-known bacterial toxins, such as the toxins of the diphtheria bacillus and streptococcus, and the toxins ricin and abrin derived from the higher plants.

PROFESSOR A. C. ABBOTT, of Philadelphia, presented a paper prepared by himself and Dr. D. H. Bergey, on 'The Influence of Alcoholic Intoxication upon Certain Factors concerned in the Phenomena of Hæmolysis and Bacteriolysis.' The authors' experiments indicate that the increased susceptibility to infection seen in alcoholized rabbits is, in part at least, explainable through a reduction in the amount of 'protective proteids,' normally present in the blood. They found the power of restoring to a heated immune serum its hæmolytic property to be from fifteen to twenty-five per cent. less in the serum from alcholized than in that from normal rabbits. This they interpret as a reduction of the usually present ferment-like 'complement' of Ehrlich and Morgenroth, a body regarded by those authors as essential to the mechanism of vital resistance to infection.

Professor J. C. Wilson, in a paper on 'Osteitis deformans,' communicated some facts in regard to this rare disease which was first described by Paget in 1877. He thought it might be due to (1) infection by some organism to the action of which bone tissue is especially liable, or (2) to the default of some physiological principle which normally regulates and limits the growth of bone. Either of these views may serve as a working hypothesis for investigations into the causes of the disease.

Professor Lewis M. Haupt, of Philadelphia, a member of the Isthmian Canal Commission, presented a paper, fully illustrated by lantern slides, on the proposed 'Isthmian Canals.'

Professor M. D. Learned, of Philadelphia, presented the final paper of the meeting on 'Race Elements in American Civilization and an Ethnographical Survey of the Country.' This paper presented in condensed form the importance of a thorough investigation of the race elements in our American life and institutions, with illustrations from the influence of the German element upon American agriculture, industry, trades, commerce and particularly upon our educational and scientific methods, our social and economical life and our art and literature.

The plan of an 'Ethnographical Survey' has already assumed practical form, and an expedition is being equipped for the coming vacation. The work will furnish data of wide range, on the survivals of early German culture, the architecture, geographical distribution, migration of early settlers and the present economic, sociological, industrial and other cultural conditions of the German element.

The social features of the meeting were most enjoyable. Luncheon was furnished at the hall of the Society on Thursday and Friday and many opportunities were afforded for making and renewing acquaintances. On Thursday evening a largely attended reception was given in honor of the members of the Society at the University of Pennsylvania. On Friday evening the visiting members were the guests of the resident members at dinner at the Hotel Bellevue on which occasion one hundred and eighteen members were present. At the close of the dinner Professor W. B. Scott, acting as toastmaster, introduced in happy vein the persons named below, who responded ably and delightfully to the following toasts: 'The Memory of our Founder,' Mr. Samuel Dickson; 'Our Sister Societies,' Professors Edward S. Morse and J. McKeen Cattell; 'Our Universities,' President Francis L. Patton and President Ira Remsen; 'The Future of Science,' Dr. Wm. Osler; 'Our Guests,' Professor H. Morse Stephens.

At the close of his remarks Professor Stephens proposed a toast to 'The Health and Continued Prosperity of the American Philosophical Society,' in which all present joined.

OUR SISTER SOCIETIES.*

I realize the honor of being asked to respond for the National Academy of Sciences to the toast 'Our Sister Societies.' In a sense the National Academy of Sciences may be considered more intimately related than a sister, for on its organization and incorporation by the National Government in 1863 we find among its fifty members forming the corporate body the largest number from any one place were

* Speech at the dinner on the occasion of the recent general meeting of the American Philosophical Society.

Philadelphians, and all of these were members of the American Philosophical Society. Its first president was one of your number as well as one of your presidents—Alexander Dallas Bache; and the man who was intrusted with the treasurership was another Philadelphian, and a member of your society—Fairman Rogers. More than half its members to-day are members of your Society. There is every reason why the two societies should be strongly affiliated; they are both working in the same spirit and in similar departments of research, and for a similar purpose—the advancement of science; and in that advancement of science the question is never asked whether it will be for the benefit of man or not. Cherished beliefs are shaken, dreadful doubts are engendered, but mysterious is the fact that the advancement of truth and knowledge tends to the bettering of man's condition. The duration of human life has been lengthened, the hours of labor shortened and an advance in human comfort has been attained. Plagues have been confined to those countries where fetich worship takes the place of observation. These, however, are trite and well-worn statements. What we should ask ourselves is, have the sister societies any other duties beside those of accumulating museum material and publishing transactions? With the knowledge embodied in these publications should we not in some way convey the results of our methods to the masses?

The aggressive actions of the temperance advocates have gone so far as to prepare and cause to be introduced into our common schools text-books urging their cult in a way that, considering the mission of the societies, is decidedly intemperate. Following their example we shall have forced upon us by ignorant school boards pleas for anti-vaccination. With the record of a hundred thousand astrologer's almanacs sold in London last year and the cultured city of Boston supporting astrologers and clairvoyants by the score, as attested by the advertising space accorded them in the daily press we may look forward for text-books on palmistry, astrology and the like in the near future. Should not an effort be made to formulate principles which underlie phenomena? Quetelet insisted upon the value of large numbers whether in measurements or statistics. A child should be made to understand the value of averages, the importance of a curve. Let us have a text-book on civil service reform. On the hundredth anniversary of your incorporation, in 1880, one of your members, Mr. Snowden, Chief of the United States Mint, made an admirable address on the necessity of civil service. This was buried in the records of that great meeting. Consider how graphically the principles he urged could be placed before the grammar school classes. Such an exposition would be prefaced by the great principle of natural selection with its fascinating illustrations from the animal kingdom. The economy of civil service could be shown in that we directly select the fittest without first killing nine tenths of the population. It would not be amiss to show how near we are to the barbarian in many ways, in that we do not profit by example. We contemplate with delight the perfectly governed cities of Birmingham and Berlin, we see the great reduction in the death rate by the introduction of pure water in Munich and in ten great cities of Great Britain, yet, with an equally intelligent population in our country, consider the management of some of our great cities in these matters.

In some way should be brought to the comprehension of the masses the relation of quantity and quality. I have elsewhere called attention to the absurd contrasts often made in the public press to illustrate the magnificence and grandeur of our country. We are told, for example, that Texas is larger than the whole of Europe, not including Russia, yet if Texas were concentrated to a square rood it would not contain as much art, science or music as may be found in many of the hundred smaller towns of Germany. We are told that the two Dakotas are as large as Greece. This comparison is as ludicrous as to say that Daniel Lambert was six times as large a man as Raphael. A bound volume of the Bloody Gulch *News* might exceed in weight and size the first folio of Shakespeare, a crematory for garbage might have a chimney exceeding in height Bunker Hill Monument. These are the kinds of figures we are told our boys and girls should know. Our people need to be taught the true value of comparison. They will be none the less patriotic, but they will be the more eager to establish and sustain with generous hand those kinds of institutions which make Europe so attractive to every intelligent American. Precisely how this work is to be accomplished I do not know, but it would seem that scientific societies, by the appointment of committees, should embody the principles of science so that the young mind may gradually grow to a comprehension of the right way of living and thinking. There is a scientific way of dealing with crime and vagabondage; there is a scientific way of administering charities, there may be a way of showing the survival in the human mind of belief in omens and dreams; and the child should be taught to appreciate the condition of a man, otherwise intelligent, in whose brain there survive a few molecules that lead him to believe in hallucinations. Even at the present time we see surviving in a few brains the ancient and almost universal belief that the world is flat.

This work should be international. We have so many international agreements, such as signals at sea, longitude and latitude and an international postal union; let us have international text-books to make the twentieth century leave its fetiches, its idiocies, its enslavements to the vagaries belonging to the imagination, and realize, in the words of Huxley, that 'Science is teaching the world that the ultimate court of appeal is observation and experiment and not authority, she is teaching it to estimate the value of evidence, she is creating a firm and living faith in the existence of immutable moral and physical laws, perfect obedience to which is the highest possible aim of an intelligent being.'

Edward S. Morse.

SCIENTIFIC BOOKS.

Inductive Sociology, a Syllabus of Methods, Analyses and Classifications, and Provisionally Formulated Laws. By Franklin Henry Giddings, Ph.D., LL.D., Professor in Columbia University. New York, The Macmillan Co. Pp. xviii + 302.

A new book by Professor Giddings is an event of first-rate importance among the sociologists. The present volume is notable not merely because anything produced by its author is bound to attract attention. It is in many respects the maturest and most important of his publications. One fact among others will be better appreciated within the craft than among other specialists. Professor Giddings has very pronounced peculiarities of view with respect to both material and method of sociology. In the present volume those peculiarities stand out more distinctly than ever. Their reception by the sociologists is likely to be much more tolerant, and even sympathetic, than could have been the case ten years ago. This indicates not so much that Professor Giddings' views will be accepted, as that differences which seemed essential ten years ago have come to be regarded as variations of points of view, and of emphasis; while other differences concern matters of method which are not mutually exclusive, but which are largely questions of very complex relativity. Sociologists will find very much to applaud in this book, even though it diverges farther from the trunk-line of sociology, as some of them see it, than his earlier works.

The contents of the book are likely to be summarily and seriously misjudged by scholars in other sciences who merely give it casual notice. It seems to propose quantitative measurement of phenomena which obviously cannot be controlled, and to do the measuring by means of units which are both vague and variable. For instance, four types of individual character are posited: The forceful, the convivial, the austere, and the rationally conscientious. In an appendix the geographical distribution of these types in the United States is shown by an outline map shaded to correspond with the supposed predominance of the types respectively. The resident of Illinois, who finds himself in the 'austere' belt is provoked to inquire whether his previous impressions of miscellaneousness among his neighbors are utterly at fault. If he happens to live in Chicago, which, like other large towns, is classed as 'rationally conscientious,' he may turn to the text for the formula of himself and his fellow-townsmen. It runs in this fashion (p. 83): "This type is the product of a reaction against and progress beyond the austere character. It is usually developed out of the austere type. Like the austere, it is strongly conscientious, but it is less narrow in its interpretations of what constitutes harmful self-indulgence, and is more solicitous to attain complete development of all powers of body and mind. It enters all respectable vocations, but is much occupied also with liberal avocations, including literature, art, science and citizenship. Its pleasures are of all kinds, athletic, convivial and intellectual, including enjoyment of the arts; but all pleasures are enjoyed temperately." If one were disposed to be facetious, here is abundant occasion. But this is merely a sample of many features in the book which equally stimulate the sense of humor. Sceptics about sociology, who on general principles come to the book to scoff, will hardly remain to pray. They will pronounce the whole affair absurd. But his colleagues know that Professor Giddings is not a man given to absurdities, and the very boldness of his drafts on their attention forbids snap-judgments. The clue in all these cases is to be sought in the difference between illustration and demonstration, and in the probability that Professor Giddings points out to his students, as scrupulously as any of his critics would, the approximate nature of such characterizations at best, and the limitations that must govern their application to masses.

But the sceptic will insist: 'What scientific value can there be in a method that deals with terms so inexact?' As will appear presently, my estimate of the relative importance of Professor Giddings' method for sociology is almost the inverse of his, yet whatever be the true ratio, sociologists ought to unite in testimony that they understand Professor Giddings, and that his program deserves scientific consideration.

The volume is divided into two books, entitled: I., 'The Elements of Social Theory'; II., 'The Elements and Structure of Society.' Book I. treats of the logical and methodological correlations of sociology with other divisions of knowledge. Though the author's individuality appears in these chapters at many points, the crux of the book is not in the prolegomena.

Book II. is divided into four parts, each containing four chapters. The titles are: Part I., 'The Social Population'; Part II., 'The Social Mind'; Part III., 'Social Organization'; Part IV., 'The Social Welfare.'

A disciple of the school of Schaeffle may be permitted to remark that, in spite of endless differences of detail, the outline which Professor Giddings draws from these points of departure connotes essentially the same fundamental ideas which 'Bau und Leben' developed. After all the contempt which has been heaped upon that work by men of other schools, such an independent and virile thinker as Professor Giddings is merely prospecting along the lines of Schaeffle's survey. This does not mean that Professor Giddings is either a conscious or an unconscious imitator. His originality is beyond question. It means that, up to a certain point, Schaeffle described the essential facts of society so truly that nobody who studies society objectively can avoid representing the facts, provisionally at least, in forms which vary from his only in detail. Each new examination of the facts leads up to or builds upon an analysis substantially equivalent to his. Professor Giddings' conception of the things involved in general sociology is simply a variation of the 'General Theory of Forms and Functions (Social Morphology, Social Physiology, and Social Psychology),' contained in 'Bau und Leben,' Part I. The biological figures which Schaeffle uses so liberally are a mere accident. The relations which he formulates are the same reactions of persons upon persons which all sociologists must sooner or later take account of in substantially the same manner. Professor Giddings' hint (Preface, p. x), that while the present volume deals with 'only one-half of the field of general sociology' the other half, as he views it, consists of social genesis, corresponds with Schaeffle's second division, 'The General Theory of Evolution.' The teleological thread running through Professor Giddings' Part IV. is quite in the spirit of the telic theory that pervades Schaeffle's treatment. These facts are worth noting, as a commentary on the prevailing impression that sociology is merely a group-name for a litter of unrelated opinions. The sociologists have given occasion for this idea by magnifying the minutiæ of their differences. All the while a consensus has been forming, which will presently justify itself as the framework within which our whole conception of life must be arranged. Distinct as are the individual elements in Professor Giddings' work, it should be said that they are incidents in the development of a common body of sociological doctrine, and that their value is in proportion to their compatibility with that containing whole.

Of the four parts of Book II., the first traverses well-worn ground of anthropology and ethnology, though not in the beaten tracks. The chapters are entitled: I., 'Situation'; II., 'Aggregation'; III., 'Demotic Composition'; IV., 'Demotic Unity.' In each of these chapters the author has made important suggestions as to the technique of the subject. For reasons that will appear later, however, we may neglect details at this point, and speak more particularly of Part II. Though this portion occupies but 125 of the 302 pages in the whole work, it contains the most original features of the argument. The arrangement is as follows: I., 'Like Response to Stimulus'; II., 'Mental and Practical Resemblance'; III., 'The Consciousness of Kind'; IV., 'Concerted Volition.' While, for reasons to be stated in a moment, I do not believe that these chapters are properly sociology at all, and while I do not believe that they indicate the most advantageous passage out of psychology into sociology, they are brilliant and inspiring in almost every line. The psychologist, however, rather than the sociologist, is the competent judge of their contents. These reservations do not apply to the chapter on concerted volition. Its value, both as a stimulus of sociological research and as an indication of sociological and social demands upon psychology, would justify very emphatic praise.

Instead of entering upon microscopic examination, it seems better worth while to offer two cardinal criticisms of the book. It should be said in advance that, from the sociologists' point of view, the propositions to be urged against Professor Giddings charge sins of omission, not of commission. They recognize the positive service which his work has rendered, but they aim to fix its relation to the development of sociology in general. The first proposition accordingly attempts to place Professor Giddings' work more definitely than its author does, in correlation with other work. The second points out one of its limitations.

First then, as was hinted above, the work is primarily and predominantly not sociology, but ego-ology. Its vanishing point is not society, but the individual. As we have seen, Part I. of the argument proper (Book II.) is anthropology and ethnology. Three quarters of Part II. must be classed as psychology without benefit of society. To the layman this may appear a petty matter. What difference does it make whether the work bears the label of one shop or another, so long as it is good work? It really makes a great deal of difference. There either is or is not a need of several kinds of shop. So long as the work is done indiscriminately in one, the same processes with the same tools being performed by different men; or so long as processes which require the technique of the shop are abridged by a right which assumption of a distinctive name is presumed to confer upon some outside workers, there is danger both that the work of the shop will be inferior, and that there will be costly delay about differentiating the shops. There are tremendous problems for workers in the sociological shop. They will not get their eyes fairly trained on those problems till they are willing to depend upon the workers in the psychological shop to mind their own business.

In the last analysis, Professor Giddings' view of the relations of anthropology and psychology to sociology probably do not essentially differ from those which prompt this criticism. The former sciences are absolutely necessary foundation-layers and tests of all sociological conclusions. The sociological interest is not however the anthropological or the psychological interest. Professor Giddings has nevertheless illustrated a very prevalent tendency among the sociologists to suffer seduction from their proper problems by interest in problems already claimed by other divisions of labor.

Professor Giddings devotes himself to making out, by a large number of differentia, the distinguishable physiological, intellectual, emotional and moral types of individual. Now I have not a word to say against the value of this work, nor do I question its ultimate bearing upon sociology. What I do urge, however, is that this is business for the anthropologist and the psychologist, while the sociologist would do better to make requisitions upon these specialists for information within their own field, and devote himself to statement and study of problems which, from his point of attention, are social first and individual second. It is certain that individual types of the sort which Professor Giddings suggests will never be made out with sufficient accuracy to have any scientific use, unless they are determined by the measurements of the appropriate laboratories. Sociologists would promote science very much faster if they would devote the same amount of strength which they now expend in labors outside of their own field to creation of an effective demand for the labors of the proper specialists.

The point may be illustrated if I suppose myself an imitator of Mr. Howells' visitor from Altruria. Suppose I am an investigator from Utopia, where we will assume intercourse between persons is all purely spiritual, with no material aims or media. My astral body hovers over New York harbor, and my purpose is to find out as much as possible about the means and ends of what I hear the New Yorkers calling 'business.' I note certain differences in the craft plying in all directions. Suppose that, like Adam, I am inspired to apply fit names to the creatures; thus, canal-boat, ferry-boat, lighter, tug, dredge, excursion-steamer, tramp, liner, pilot-boat, coaster, fishing-smack, battle-ship, etc. Now suppose I make up my mind to enlarge my ideas of 'business' by taking these different craft as my clues, and that I proceed to hunt down the part which each type plays in 'business.' The present argument is that it would be more to the purpose for me to attempt this by starting with the registration and clearance papers of these craft, and by following them as they go about their several kinds of work, taking all preliminaries for granted, than it would be for me to probe back in the other direction, through the architectural construction of the craft, down to the chemical and physical properties of the materials so assembled. That is, if my immediate interest is traffic, it is poor economy for me to specialize on questions of marine architecture, and chemistry and physics. This is not to deny the relation of traffic to technical and pure science. Neither the science, on the one hand, nor the commercial knowledge on the other, will be complete till it is a synthesis of both; but it would be just as evident a mistake for me, in pursuit of knowledge of 'business' to concentrate my attention on pure science, as it would, if I were in pursuit of pure science, to concentrate my attention upon business.

Now to go back to Professor Giddings as a type of the sociologists. We shall never completely understand social reactions until we understand the physiological, psychological, emotional, and moral composition of individuals. On the other hand, we shall never fully understand these elements until we entirely comprehend the social reactions in the course of which these elements are evolved. Meanwhile it is the fond folly of the philosophic temper to invert values, and plan to learn most about the thing that interests us most by neglecting it and studying most the thing that interests us least. It is not less fatuous because, forsooth, there is an ultimate interdependence between these objects of less and greater interest. Such reversal of a practical order amounts to a confession of unfaith in one's own appropriate scientific mission, and in that of others as well. Cannot other scholars be trusted to do their own work better than we can do it for them, and have we nothing to do which others have not fitted themselves to do as well? The strictly sociological questions center around *the fortunes of men in association.* The strictly physiological and psychological questions center around the *make-up of the persons associating.* Either of these groups of problems is a perfectly legitimate sphere of scientific interest. Neither of them is an exclusive sphere. Each runs into the other. It is, however, forsaking specialization for amateurism if the men whose center of interest is in the social sphere give their time to exploiting hypotheses in the individual sphere, and *vice versa.* As Professor Giddings assumes, in abundant and striking examples, in the chapter on concerted volition, the typical sociological questions are: How do men associate? For what purposes do they associate? How do they come to change the types of their associations? What are the reactions of the different types of associations upon the persons associating, and of the persons associating upon the different types of associations? Our answers to these questions will be false if we cut loose from the involved facts centering in the individual; but knowledge of these two phases of the common reality will have to grow through persistent use of the distinct centers of attention, not by abandonment of the one for the other.

For the sociologist to try to be at the same time a successful ethnologist and a laboratory psychologist, in the hope of building up social facts from the elements, is hardly less naïve than the program which has been adopted and abandoned in disgust so many times by over-conscientious historians. They have decided to go back and find a point which they might take as absolute beginning of the evolution which they wanted to trace, and they have resolved from that point to clean up everything as they went along, leaving no unfilled gaps, and no unattached material. In practice they have been obliged to choose between forever pushing backward in search for the origin of the origins, or starting somewhere and tracing certain series of apparent evolutions, neglecting many factors that are doubtless concerned in the evolution, in order to be free to consider any series at all.

In actual experience, as contributors to knowledge rather than as middle-men, we must virtually choose in the same way, between physiology and psychology on the one hand and sociology on the other. Neither division of labor is going to succeed in cleaning up everything as it goes. Psychology will at one stage limp because it lacks support in sociology, and again sociology will be top-heavy because its center of gravity is not down close enough to psychology; but science will progress best if the sociologist sticks to sociology, and takes his psychology from the psychologists, instead of trying to be his own psychologist; and *vice versa.*

Professor Giddings is attempting to interpret society in terms of that abstraction which we called 'the individual' before we realized that it was an abstraction. This, I think, accounts for the fact which Professor Ross points out in a highly appreciative review of 'Inductive Sociology' (*Am. Jour. of Sociol.*, January, 1902), viz., that the title of Book II., Part II., Chap. II., 'Mental and Practical Resemblance,' is a misnomer. The chapter is a most sagacious qualitative analysis of individual traits, and a formal determination of types marked by the traits. Apparently, however, Professor Giddings' thought is in this form: "These traits in the individual, A, resemble the traits in the individuals B, C and

D. Therefore these like individuals make the type X." He consequently credits himself with classifying resemblances. If his viewpoint were strictly that of society rather than of the individual, he would see that he thereby checks off but a single step in his process. When he takes the next steps, and determines the types Y, Z and W, he does it by means of their differences from X and from each other. This is the longer and more important step and, as Professor Ross intimates, he should have designated it accordingly. The study of individuals is not sociology, any more than the study of bricks would be architecture. I would not prejudice my case by seeming to say that Professor Giddings has not studied sociology. He has of course for years been among the men who have studied it in all its dimensions. The present thesis is that the individual and the theory of the individual subtend too much of the angle of Professor Giddings' vision. The consequences are, first, that he does not draw a sharp methodological line between the sciences of the individual and the science of society; second, that his own work is, more than he is aware, on the individual side of the point where the division line ought to be; third, that the conclusions which he carries over to the social side of his thinking are arbitrary constructions of artificial individuals into a conventionalized social whole.

The second chief count against the book is that its organizing sociological conceptions belong in a period out of which sociology has definitely passed. As was said above, they are essentially the ideas of Schaeffle. To have thought Schaeffle's thoughts ten, or even five, years ago was a merit. Not to have thought beyond them to-day is a demerit. Professor Giddings' Part III., 'Social Organization,' and Part IV., 'The Social Welfare,' attempt precisely what Schaeffle attempted in the corresponding parts of his work. The results in the later instance do not suffer by comparison with the earlier, but no doubt Professor Giddings will be among the first to realize that a new idea is breathing the breath of life into the dead clay of structural and functional classifications. It should be admitted, in extenuation, that the only safe way to insure against the appearance of lagging behind the progress of sociological theory is to refrain from publishing a book. The movement of thought has been so rapid that an author is fortunate not to have outgrown his plan before his last chapter is in type. The probabilities are that Professor Giddings is no exception to the rule, and that the new impulse has exerted its full force upon him. It would be an injustice to hundreds of contemporaries in many divisions of science to credit this new impulse to any single individual; but Ratzenhofer has given it such detailed expression that it would not be at all strange if the present stage of sociological development were presently reckoned as dating from the appearance of 'Wesen und Zweck,' in 1893.

The center of gravity of the newer sociology is in the *interests* which move the machinery of association. Everything else becomes secondary. Instead of stopping with structural and functional formulas, as the last expressions of the social fact, we realize that societary structures and functions are merely vehicles of the essential content. The central reality in association is the evolution and correlation of interests. This perception produces a new critique of our whole structural and functional tradition. It furnishes a lens through which to see whether our sociological categories are elaborations of sterile technique, merely flattering its inventors, or whether they actually correspond with the interests which produce and operate and reconstruct the social forms.

Professor Simmel has lately remarked (*Inter. Monthly,* February, 1902, p. 183) that the real significance of historical materialism must be found in the fact that it is "the first attempt to explain history by means of a psychological principle. If hunger did not cause pain, if it were not, besides having its physiological function, a spiritual event, then it would never have set free the events that we call history." Anticipating the conclusion that 'historical materialism is altogether too narrow an hypothesis,' he observes two pages earlier: "The general synthesis that shall unite all the currents of existence as known to us into consistent ideas, that shall convert all external reality into spiritual values, and satisfy all the needs of the spirit with the results of knowledge—this great synthesis we still await." All men who study life, and indeed all who live, will contribute to this synthesis. The sociologists have volunteered for a part of the work which is more general than that attempted by either of the older divisions of labor within the group of the positive sciences. It is nothing less than the frank attempt to achieve this synthesis. The most credible clue which they have discovered as yet is that the key to the interpretation of life is not one interest, but all interests. The immediate quest of the most alert sociology is a conspectus and a calculus and a correlation of the interests which actually impel real men. This quest is completely readjusting the sociological perspective. It is making us feel that we have been dealing with the stage-settings instead of the actors. It does not, and it cannot do away with knowledge of the mechanism of social structure and function, from the bodily tissues and mental traits of the units up to the conventions of world-society. It is beginning to enforce the conviction, however, that these are finally to be understood, not as their own interpreters, but as interpreted by the more vital realities, *i. e.*, the interests that produce and use them.

The change that has come over sociology is not unlike the shifting of attention in botany from the making of herbaria to the study of ecology. The change is taking us out of an atmosphere of isolated cases, on the one hand, and of desiccated metaphysics on the other, into the real life of men. We have to find out what men want, why they want it, in what proportions to other things that themselves and others want, how the wants depend upon each other, how association is related to these wants (the real passage from psychology to sociology), and how to appraise the same in settling upon a theory of the conduct of life. With this perception at the fore, our venerable structural and functional sociology begins to look like a treatise upon the instruments of Sousa's band by a man who had not found out what they are all for.

The conclusion of the whole matter is not that appreciation of Professor Giddings' book was promised at the beginning, only to be withdrawn at the end. The sort of work which the method proposes will have to be carried on by somebody until we have the kind of knowledge that it seeks. It requires the prevision and the courage of the seer to advertise a program which is sure at the outset to impress men in the exact sciences as quixotic. My conviction that analysis of interests and determination of interest-groups is more fundamental and more enlightening than classification of types on any less essential basis, makes me insist that Professor Giddings' program is not the most timely. It points, however, toward something which must sooner or later have its time. It is a powerful argument to the effect that the really fruitful work of psychology is virtually not yet undertaken. It should have the effect of a keen spur in promoting the development of both psychology and sociology.

Albion W. Small.

The Microscope and its Revelations. By the late Wm. B. Carpenter. Eighth Edition, edited by W. H. Dallinger. With 23 plates and nearly nine hundred engravings. Philadelphia, P. Blakiston's Son & Co. 1901. Price, $8.00.

This standard work of reference has undergone another revision to keep it abreast the rapid advance in microscopical optics and construction during recent years. Two years ago with the appearance of the seventh edition the work was entirely rewritten, and while the changes now are less extensive they embrace the complete reconstruction of eight chapters, covering about one half of the 1,100 pages of the book. The portion rewritten treats of the principles of microscopical optics and of vision with the compound microscope, the history and evolution of the instrument and its accessories, the manipulation of apparatus, the preparation of objects and the application of the microscope to geological investigations. In this work the author has had the assistance of such well-known authorities as E. M. Nelson, A. B. Lee, E. Crookshank, T. Bonney, W. J. Pope, A. W.

Bennet, F. J. Bell and others, with the result that the volume will remain, as it has been, the most useful and extensive work of reference in this field. The illustrations, always numerous in former editions, have been largely increased and are excellently chosen.

Especial mention should be made of the chapter of 150 pages on the history and development of the microscope, the scientific presentation of which is full of interest; with its extensive illustrations, many of which are new, it forms by all odds the most complete study on the evolution of the present form of the instrument accessible to the student. Here is proposed the following scheme for the classification of instruments which makes their criticism and comparison more intelligible and constitutes the first effort in this direction. This classification is as follows:

Microscopes placed in Class I. possess—

1. Coarse and fine adjustments.
2. Concentric rotation of the stage.
3. Mechanical stage.
4. Mechanical substage.

Class II.

1. Coarse and fine adjustments.
2. Mechanical stage.
3. Mechanical substage.

Class III.

1. Coarse and fine adjustments.
2. Plain stage.
3. Mechanical substage.

Class IV.

1. Coarse and fine adjustments.
2. Plain stage.
3. Substage fitting (no substage).

Class V.

1. Single adjustment (coarse or fine).
2. Plain stage.
3. With or without substage fitting (no substage).

This classification applies also to portable miscroscopes.

Of American instruments Dr. Dallinger speaks very highly more than once, saying in one place, 'The recent microscopes of the best American makers are characterized by the highest quality of workmanship and abundant ingenuity,' and especially commending as an 'admirable feature' that the makers here "avoid sharp angles and knife-like edges on all their instruments. This looks a trifle, but the use of the microscope with saprophytic, pathogenic or other infective material requires the utmost caution that the skin of the hands should be unbroken."

Dr. Dallinger's views on the continental model of stand are so well known that one can not be surprised at the position taken in this work; but the manner in which this opinion is expressed is so catholic and the criticism is so full of truth that the reader, whatever his views, feels himself brought into sympathy with the author. The following excerpt shows the tenor of this discussion:

Our one purpose in this treatise is to promote what we believe to be the highest interests of the microscope as a mechanical and optical instrument, as well as to further its application to the ever-widening area of physical investigation to which, in research, it may be directed. To this end throughout the volume and especially on the subject of the value and efficiency of apparatus and instruments, we have not hesitated to state definitely our judgment, and, where needed, the basis on which it rests. Incidentally we have expressed more than once our *disapproval*, and, with ourselves, that of many of the leading English and American microscopists, *of the form of microscope known as the Continental model;* we believe it is not needful to say that we have done this after many years of careful thought and varied practice and experience, and, so far as the human mind can analyze, without bias. It is not where a microscope is made that the scientific microscopist inquires first, but where it is made most perfectly. * * * The more recent instruments of Continental model are marvels of ingenuity. * * * There is no fault in the workmanship; it is the best possible. *The design alone is faulty;* there is nothing to command commendation in any part of the model. * * * To all who study carefully the history of the microscope and have used for many years every principal form, it will, we believe, be manifest that the present stand of the best makers is an overburdened instrument. Its multiplex modern appliances were never meant to be carried by it.

The chapters on the microscopic forms of life are extensive and well illustrated, yet they constitute the least satisfactory portion of the work; indeed some of the sections are seriously out of date. It is the lower types the treatment of which is most evidently insufficient, and among the Protozoa, Cœlenterata and Vermes much recent work of great importance is omitted. Thus it is hard to see why the Flatworms, which are both of general and also of special clinical interest, should have been passed over with merely three pages of text and no illustrations; and the dismissal of malarial organisms by the citation in a brief footnote of a few authorities generally inaccessible, does not conform to the purpose of the work or to the manner in which other topics are handled. These are, however, instances from chapters of which a few have not been revised in either of the recent editions of the book.

In general the work has been carefully and thoroughly revised and brings together in convenient form a mass of valuable material which can hardly be found in any other single volume. It is indispensable to the amateur worker with the microscope who wishes assistance or information on the many problems which arise in his work, while biologists and others to whom the microscope is a professional instrument will find it a reference book of real value.

Henry B. Ward.

PERNTER'S METEOROLOGICAL OPTICS.

An important work on the optical phenomena that occur in meteorology is announced from the press of Wilhelm Braumüller, of Vienna, viz., 'Meteorologische Optik,' by Professor J. M. Pernter. This work is the fruit of the author's studies for twenty years past and represents the lectures that he has delivered to students in the universities at Innsbruck and Vienna. He proposes to thoroughly work over a field in the physics of the atmosphere that is often neglected by meteorologists, although in many respects of importance to those who are studying the dynamics of the atmosphere. Although treatises on meteorological optics have been published by Clausius, Mascart and others, yet, it is to be expected that this volume by Pernter will be the first that has done justice to the subject. The whole work will be divided into four sections, relating respectively to the apparent shape of the celestial vault; the phenomena due to the gaseous components of the atmosphere, such as refraction and scintillation; those due to haze or cloud, such as halos, glories, rainbows and the colors of the clouds; finally, the phenomena due to very small particles of any kind always existing in the air, such as the blue color of the sky, the polarization of skylight, twilight and the absorption of light in the atmosphere. The first section, price 2 Kroners, or 45 cents, has already appeared, covering 54 pages of large quarto, and shows us that the whole work, which will embrace about 480 pages, is eminently worthy of commendation.

C. Abbe.

SCIENTIFIC JOURNALS AND ARTICLES.

Bird Lore for March–April opens with a most interesting article by William Brewster on the 'Voices of New England Marsh,' in which we are given a picture of the cycle of life throughout the year as indicated by the voice of the residents. The second article, on 'Bird Clubs in America,' is by S. N. Rhoads, and tells of the Delaware Valley Club. Edith M. Thomas contributes a poem on the 'English Starling,' and the third paper on 'How to Name the Birds,' by Frank M. Chapman, treats of the orioles and finches. Lawrence F. Love tells of 'My Bluebirds,' and we have reviews, editorials and the Audubon Department to complete the number.

The Osprey for March has 'Notes of some Yellow-throated Vireos' Nests,' by William R. Maxon; 'The Birds of the Marianne Islands and their Vernacular Names,' by W. E. Safford; 'Notes of McCown's Longspur in Montana,' by P. M. Silloway; 'The Carib Grassquit (*Euethia bicolor omissa*),' by B. S. Bowdish and a 'Biographical Notice of John Cassin,' by Theo. Gill, besides shorter articles and reviews. The supplement on 'The General History of Birds' continues the description of the feathers.

The Museums Journal of Great Britain has a brief article on 'Museums and Teaching,' which is rather flattering to American museums, an article by W. H. Edwards on 'An Economical Method of Mounting Shells and other Small Objects for Museums,' and the fourth instalment of 'Hygiene as a Subject for Museum Illustration' gives the scheme of arrangement for the domestic, communal and dwelling divisions. There are a description of 'The Stone-Age Gallery,' British Museum, and a note on the 'Transvaal State Museum,' from which it appears that England has granted about £8,000 for its completion. If Great Britain can give this sum for this far-away Museum, it would seem as if the United States with its claim to be the richest nation in the world might provide a new National Museum.

The American Museum Journal for March contains an abstract of the annual meeting of its trustees, a note on 'A Fossil Armadillo from Texas,' the program for 'The International Congress of Americanists' and a note on the remarkable beetle, '*Hypocephalus armatus* Desmarest.' The 'Guide Leaflet' accompanying the number is by J. A. Allen and is devoted to 'North American Ruminants.' It comprises twenty-eight pages, an account of the group, containing much information, and is abundantly illustrated from living animals and from the museum groups. The title page and index to Vol. I. of the *Journal* is also issued.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON.

THE 353d meeting was held on Saturday evening, April 5.

Frank Baker and F. A. Lucas discussed the question, 'Is the Area of Muscle Insertion an Index of Muscular Power?' Frank Baker stated that it had been assumed in discussing the flight of birds that because one bird had a larger area of wing muscle than another it necessarily exerted much more power in flight, while there were other points to be considered, such as the character or quality of the muscle fibers and their nerve supply. Dr. Baker then proceeded, with the aid of numerous lantern slides, to show that the internal structure of muscle varied much, so that one muscle might have vastly more power than another of equal bulk, while again there might be a vast difference in the contractile power of the individual fibers. The rapidity with which a muscle might contract and relax, and the energy or force it might expend in doing this, would be influenced by the manner in which the nerves were distributed, and this, the speaker showed, varied very much. The powerful water beetles were cited as affording an example of peculiar nerve distribution probably correlated with the exercise of great strength, and it was stated that investigation would probably show that there were decided differences of nervation between birds of rapid flight and those slow of movement, and that other factors besides mere area of muscle insertion entered into the question of power exercised by flying animals.

F. A. Lucas, in presenting his side of the question, said that while he agreed with Dr. Baker that the area of muscle insertion was not necessarily a measure of muscular power, in certain cases he thought it might be. In estimating the amount of power expanded by birds in flight, he had used the area of the keel of the sternum as a rough index of the force used. Mr. Lucas explained that in all birds the main muscles that raised and depressed the wings arose from the sternum and acted in the same way. In birds which flew by strokes of the wings, and whose flight was undeniably powerful, the breast muscles and sternal keel were in direct ratio to the apparent force, while the muscle insertions on the humerus were also large. In birds which sailed, like the albatross, the sternal keel and breast muscles were small. In certain birds, such as the tinamous, the quality of the muscle was poor, although the quantity was ample, and in such cases the character of the humerus and its small attachments for muscles showed that such was the case. The speaker illustrated his remarks by diagrams of the humeri of various birds, and one showing the sternum of the albatross as it actually was and as it would be did the albatross employ a force proportionate to that of the humming-bird, concluding that he felt justified in using the size of the sternum in birds as a measure of the power used.

W. P. Hay presented a paper on 'The Subterranean Fauna of the United States,' illustrating his remarks with lantern slides. He showed the areas in which caverns occur, described the manner in which caverns are formed and showed examples of various types of caves. The cave fauna was discussed in detail and compared with that of Europe. With the exception of one salamander, related to *Proteus* of Europe, and one crustacean the species of cave animals were stated to be related to, or obviously modified from existing forms of the regions in which the caverns are located. F. A. Lucas.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

The 550th meeting was held March 29, 1902.

Mr. Marcus Baker discussed this geometrical proposition: 'If one corner of a cube be cut off by an oblique plane the sum of the squares of the areas of the three faces adjacent to the corner is equal to the square of the area of the opposite side.' This can easily be proved analytically; but as the relation requires four dimensions, and no geometrical proof is known, the speaker held the relation was merely numerical. Professor Gore concurred in this view.

Mr. G. K. Gilbert presented the geophysical problem of the pressure of a glacier on its bed at a point below the surface of the sea, and the contradictory solutions that had been given.

The first regular paper was by Professor J. H. Gore, on 'The Ambiguity of the Double Sign' $\pm$ occurring in the extraction of roots. He pointed out that ordinarily we determine by experience which of these signs is the true one in a specific case; but in cases outside of experience we have no criterion to guide our judgment. This was illustrated by various examples.

Mr. C. K. Wead then spoke on 'The Theory of some Peculiar Musical Instruments in the National Museum.' The instruments included the globular four-hole whistles from Costa Rica, figured by Messrs. Wilson and Upham in the 'Museum Report' for 1896, and similar less perfect whistles in other museums, and various kinds of primitive flutes. The scales produced on these are only by accident diatonic, and the laws clearly are applicable to the instrument, not to the notes. A new generic principle of primitive scale-making was enunciated, and various specific forms of the principle. The fuller statement of these laws will soon appear in the 'Report of the U. S. National Museum' for 1900.

Mr. Upham then exhibited several of the instruments and performed on them. The type whistle or resonator gave very closely the notes F (690 d. v.), A, C, D, E.

The 551st regular meeting was held April 12, 1902.

The election to membership of Mr. S. W. Stratton, of the Bureau of Standards, and Mr. W. J. Spillman, of the Department of Agriculture, was announced.

The paper of the evening was on 'Liquid Air,' by Mr. G. A. Bobrick, superintendent of the only establishment furnishing liquid air commercially. The consumption is now about 150 gallons per week; the carriers are so well insulated that a gallon will not wholly evaporate under about a month, and recent improvements have largely diminished the loss from their fragility. The well-known experiments were fragility to show the effects of intense cold, —312° F., on various kinds of bodies, and the use of the liquid for explosives and to promote combustion. Apparatus was exhibited showing the production of the lime light by gas and liquid air. The history of the liquefaction of gases during nearly a century was given, with brief description of the three processes used; the bent tube (Davy), the cascade or closed double cycle (as by Pictet), and the self-intensive or regenerative systems. This last in practice yields a pound of liquid air per pound of coal used.

The speaker finds this an ideal source of power, where the expense is not prohibitive: seventeen gallons drives his automobile fifty to sixty miles. While it will never be used for stationary engines, it will be useful for submarine and aerial navigation. It is used in manufacturing chemicals and food extracts, and has already important medical uses.

Charles K. Wead,
Secretary.

THE GEOLOGICAL SOCIETY OF WASHINGTON.

At the meeting of the Society on April 9, Mr. S. F. Emmons read parts of an address delivered by Clarence King in June, 1877, on the thirty-first anniversary of the Sheffield

Scientific School, entitled 'Catastrophism and the Evolution of Environment.' This address was a protest against the extreme views held in those days by the British schools of uniformitarians headed by Lyell. With his own peculiar delicacy of touch, Mr. King first sketched the origin of the adverse schools of catastrophists and uniformitarians, and showed that they differed not so much in regard to the facts of geology as to the rate of geological change. He then stated that in his recent 30,000 miles of geological travel on the Survey of the 40th Parallel he found that geological history, as he read it, showed not the often unvarying rate of change of the uniformitarian, but periods of calm interrupted by others of accelerated change that in their effect upon life must have been catastrophic in their nature.

In response to man's questioning as to his origin, he said Nature vouchsafes one syllable of answer at a time. The syllable that Darwin got was the Natural Selection. Biologists consider it necessary to deny catastrophism in order to save evolution and reason only from the continuity of the paleontological record, neglecting the evidence of physical breaks in the geological record; but the latter must have varied the rate of geological change and thus brought a modified catastrophism. Natural Selection resolves itself into two laws: *hereditivity* and *adaptivity,* the latter being the accommodation to circumstances, which is dependent, half upon organism, and half upon the environment. Environment has affected the evolution of life during rapid movements of the crust or sudden climatic changes, either by extermination, by destruction of the biological equilibrium, or by rapid morphological changes on the part of plastic species. At the end of a period of uniformitarian conditions there has been a period of accelerated change in which only the more plastic forms have survived. In the future the geologists must therefore take into account periods of modified catastrophism, King says, and concludes in the following words:

"Moments of great catastrophism thus translated into the language of life, become forms of creation when out of plastic organisms something new and nobler is called into being."

Mr. F. L. Ransome spoke on 'Faulting and Mountain Structure in Central Arizona.'

The district discussed is in the Globe Quadrangle, lying in the sierra region which borders the Colorado Plateau on the southwest. Paleozoic quartzites and limestones rest unconformably on pre-Cambrian schists and granites, and all of these rocks are extensively intruded by diabase. After a long erosion interval, effusive rhyolites were erupted, probably during the Tertiary. The region was then deformed by a remarkably numerous series of normal faults. The rocks are divided into countless small fault-blocks and the prevailing structure is monoclinal, the Paleozoic beds dipping southwest at an angle of about twenty-five degrees. The strata are nowhere folded and the mountains are due to faulting, although the external forms of the faulted blocks have been considerably modified by erosion.

ALFRED H. BROOKS,
Secretary.

TORREY BOTANICAL CLUB.

AT the meeting of the Club on March 26, 1902, the first paper was by Dr. L. M. Underwood, entitled 'Notes on *Goniopteris.*' Distinguishing features, found in the venation and in the form of the indusium, were illustrated by figures. Nine species were mentioned, chiefly of the West Indies, including *G. reptans* of Florida, and species recently collected in Porto Rico and in St. Kitts.

The second paper was by Dr. M. A. Howe, 'Notes on the Marine Flora of Nova Scotia and Newfoundland.' Numerous examples were exhibited, illustrating especially the larger Phæosporeæ, including rolls of dried *Laminaria,* rock specimens bearing crustaceous species, and many others preserved in jars or by mounting in sheets. Among noteworthy species or forms found were *Fucus serratus; Fucus vesiculosus* without vesicles on the Nova Scotia coast; *Stipocaulon* at Pictou, the first discovery in North America of this genus of the Sphacelariaceæ. Examples were shown of *Laminaria longicruris* and *L. platymeris* from the Newfoundland coast whence De la

Pylaie first described them. Interesting specimens of *Agarum, Alaria, Porphyra, Gloiosiphonia*, etc., were exhibited, the *Agarum* from a deep tide-pool at Digby covered by thirty feet of water at high tide. Corallines attain great beauty in these northern waters, and with the attendant brown rockweeds and lustrous kelps lend great richness and diversity of color. The dulse gatherers were found to distinguish and prefer the dulse growing on *Laminaria* to that attached to rocks. Dulse gathering at Pictou forms a business of considerable importance; the dried dulse is put up in barrels to be sold in Boston and latterly in New York.

A third communication, by Dr. MacDougal, consisted of the exhibition and discussion of a specimen of *Ephedra*, one of two species collected by him in his recent trip to Arizona. This remarkable leafless relative of the pines produces palisade cells along its stems instead of leaves. A living cutting about three feet high was shown resembling Scotch broom in its multitudes of long green and brown branches.

Dr. MacDougal also exhibited a remarkable Arizona plant, perhaps an *Ipomœa*, with large swollen discoid base about fifteen inches in diameter, to which short roots were still attached. He had also collected there the tree *Ipomœa* known as the 'Palo Blanco' tree, on which deer browse; it bears a few flowers all the year round, but the leaves disappear after the rainy season.

EDWARD S. BURGESS,
Secretary.

UNIVERSITY OF WISCONSIN SCIENCE CLUB.

AT the meeting of the Club held on April 1, Professor R. W. Wood, of Johns Hopkins University, addressed the Club on the subject 'A Suspected Case of the Electrical Resonance of Minute Metal Particles for Light Waves,—A New Type of Absorption.'

Small pieces of sodium, lithium or potassium heated in air-exhausted glass bulbs deposit on the cold wall of the bulb in the form of a film which shows colors by transmitted light as strong as those produced by the aniline dyes. The color does not seem to depend on the thickness, and all attempts to explain it by the well-known principles of interference have been without success. The microscope shows that the deposit is made up of exceedingly minute grains, which are but just barely visible under a one twelfth inch oil immersion objective. Their diameter is not far from .0002 mm. The colors vanish on the admission of the smallest trace of air. They change in a most remarkable manner if the outside of the bulb be touched with a small piece of ice, or if the glass be locally heated. The change of color produced by the application of ice to the outside of the bulb is always in the direction corresponding to a drift of the absorption band towards the red end of the spectrum. A purple film which has an absorption band in the yellow becomes blue-green when cooled, the absorption band moving into the red.

The cause has been found to be a condensation of the traces of volatile hydrocarbons (derived from the metal) on the colored film, thus immersing the particles in a fluid of high dielectric constant, the effect of which would be to increase the capacity of the system, lower the period of vibration, and move the region of absorption towards the red end of the spectrum. This was proved by forming the film in one half of a double bulb and immersing the other half in solid CO_2 and ether, thus bringing down all the hydrocarbon vapor. The colored film was found to be no longer sensitive to the local application of ice. It became sensitive, however, as soon as the lower bulb was removed from the freezing mixture and warmed. Sometimes the film becomes nearly colorless when cooled, the absorption band moving out of the visible spectrum entirely. Films originally pale apple green become deep violet when cooled, the color being as deep as that of dense cobalt glass. Various experiments have been tried with polarized light at different angles of incidence.

The paper will appear in full in the *Proceedings of the London Physical Society* and the *Philosophical Magazine*.

C. K. LEITH.

DISCUSSION AND CORRESPONDENCE.

THE MATHEMATICAL THEORY OF THE TOP.

TO THE EDITOR OF SCIENCE: 'The Mathematical Theory of the Top,' kindly communicated for me by Professor Barus to SCIENCE of

December 20, 1901, is simplified much further by noticing that, as the velocity of H is $Wgh \sin \vartheta$ perpendicular to the plane OGK, the hodograph of H (turned backwards through a right angle) is similar to the projection on a horizontal plane of the path of a point C on the axis of the top; and thus

$$Wgh \sin \vartheta e^{\psi i} = -i \frac{d}{dt} (\rho e^{\pi i})$$

by which the vector of the projection of C is derived from the herpolhode curve described by the vector OH of resultant angular momentum by means of a simple differentiation; and this holds for the general top, not merely the symmetrical. I take this opportunity of calling attention to some misprints:* as μ for u, and p for the Weierstrassian symbol in equations (32) to (40). A. G. GREENHILL.

ORDNANCE COLLEGE,
WOOLWICH, ENG.,
April 7, 1902.

STEINER'S 'LOST' MANUSCRIPT OF 1826.

IN 1826 Steiner announced that he had a manuscript, 'Über das Schneiden (mit Einschluss der Berührung) der Kreise in der Ebene, das Schneiden der Kugeln im Raume und das Schneiden der Kreise auf der Kugelfläche,' ready for print. The subject of this paper, treated by a mathematician like Steiner, has always been considered as of fundamental importance for the development of the geometry of the circle. Since the death of Steiner (1863) until recently, all efforts of recovering this celebrated manuscript were in vain. In 1896, on the occasion of the centennial celebration of Steiner's birthday, in Bern, Dr. Bützberger found a box in the garret of the library of the Naturforschende Gesellschaft in Bern, containing several manuscripts of Steiner, *among which was also the one supposed to be lost.*

This fact is also interesting in connection with Professor Fiedler's (Zürich) investigations on cyclography for which he received the Steiner prize from the Berlin Academy of Science. In a recent letter to the writer, Fiedler remarks that he was in possession of the principles of cyclography (treatment of geometrical problems by means of circles) already in 1863, and that he waited for the publication of Steiner's collected works by Weierstrass in 1881, because he expected to find in it said paper and Steiner's corroboration of his (Fiedler's) results by a similar method. The inspection of Steiner's manuscript, found in 1896, shows however that it does not contain the slightest trace of Fiedler's method. Fiedler is therefore the founder of cyclography.

UNIVERSITY OF COLORADO. ARNOLD EMCH.

* These have already been corrected (see SCIENCE, XV., p. 440).—EDITOR.

AN UNPUBLISHED LETTER BY RAFINESQUE.

TO THE EDITOR OF SCIENCE: During the residence of C. S. Rafinesque in Sicily, after his first four years' stay in America, he was in frequent correspondence with American botanists. From them he constantly sought for collections of local plants, offering Sicilian and other European plants in exchange. The letters were written by Rafinesque during the period of greatest mental strength and activity, and hence seem to illustrate certain phases of his mental life in a most interesting and instructive manner. Letters of this period seem to be quite rare and the following, presented me in copy by Mr. Curtis G. Lloyd, of Cincinnati, with permission to use it as I should wish, seems to well illustrate in the case of Rafinesque his methods of enriching his own herbarium. So far as I have any information in the matter, Rafinesque always fully repaid these exchange debts—thus setting a most commendable example to others who may be 'less eccentric' than the Sicilian botanist. The letter was written to Dr. Manasseh Cutler, then of Massachusetts, but more recently of Ohio, and seems to confirm our general view that Rafinesque was an inveterate collector and that he used every known honest means to increase the number of sheets in his herbarium. The letter was written in 1806 and is interesting of itself. I send it to you, thinking some readers of SCIENCE may be interested in it through their knowledge of the 'eccentric naturalist.'

BROOKLYN, N. Y., R. ELLSWORTH CALL.
March 29, 1902.

PALERMO, *2nd May, 1806.*

Dear Sir:—

I confirm what I had the pleasure to write you per Alfred Capt. Felt, and another opportunity offering for Salem I cannot help entreating you again to have the goodness to comply with my request of collecting and sending me some of your most curious plants and particularly such I have pointed out in my former letters, the numerous opportunities from Salem and Boston to this place will afford you every facility in forwarding me same.

I am still expecting to hear from you if you got the plants I left for you at Francis Hotel and how you like them. If you have an European Herbarium or wish to make one I am ready to forward you specimens of the finest and nicest Italian and Sicilian plants in return from those I expect from you and beg you will command in everything else in my power.

Please to remember also to forward me Suplt. you promised me of the plants you have found in your Northern States since the publication of your paper in the American Academy Transactions.

I would entreat you to include in the plants you may send me, particularly those belonging to the tribe of Orchidean, Graminean, Calamariæ, Muci, Algæ, etc., as they are particularly interesting to me and I know you have well determined a number of them through Dr. Muhlenberg's means.

I should like to know the botanical names of all your Cherries, Vacciniums, etc., or a sketch of their descriptions (since you only mentioned their vulgar name in said paper) to enable me to discover it if you cannot send them in nature with the fruits or flowers.

I am most sincerely and with the most grateful wishes,

Dear Sir,

Your most obedient servant,

C. S. Rafinesque,
Care Mr. Bibbs Conpit,
Un Admer.
Palermo.

Dr. Manasseh Cutler,
Hamilton,
Near Salem,
Massachusetts.

favored by Mr.
Th. Bancroft.

'NODULES' IN COLORED BLOOD CORPUSCLES.

'Nodules' in mammalian colored corpuscles, such as those referred to by Professor Macloskie, were described by Mr. Victor Horsley, of London, in an address delivered on May 4, 1897, at a meeting of the 'Arztlicher Verein' at Hamburg. He did not, however, observe them in all the corpuscles, but only in some. In his paper, published, I think, in one of the volumes of collected papers from the Physiological Laboratory of University College, London, he mentions that Arndt saw granules in the red corpuscles which stained with methyl violet. Horsley's own observations were made by the intra vitam methylene blue method. In connection with my work on haemolysis, carried on during the past five years, I have had frequent opportunity to observe that when methylene blue is added to blood laked in various ways, blue granules generally situated eccentrically are revealed in some of the ghosts. G. N. Stewart.

A MUD SHOWER.

To the Editor of Science: On Saturday, April 12, at noon there occurred what has aptly been called a 'mud shower.' Collars and shirt fronts were spattered with dirt. It lasted only a few minutes, but was sufficiently unpleasant to create considerable discomfort. Window glasses on the western exposure of houses were covered with thousands of drops of dirty water. An examination of these drops with a simple microscope showed what appeared to be little membranous bags containing grains of dust. The dust particles were black with occasional instances of yellow and a few of red. The atmosphere at the time of the shower, and before, contained considerable dust. This phenomenon seems to give a striking confirmation of the dust-nuclear theory of the formation of rain drops. J. W. Moore.

Lafayette College,
Easton, Pa.

THE 'PRICKLY PEAR.'

To the Editor of Science: On page 598, issue of April 11, 1902, is printed the item that the Government of Queenland has offered a reward of $25,000 for the invention of some satisfactory means of destroying the 'prickly pear.' If this refers to the common Missouri cactus, would it not be well to follow the Mexican in making it a useful food for cattle and sheep, by cutting the plant to the ground, and throwing it on piles of dry brush, which are fired, and the spines scorched off, when it is greatly relished by the stock.

CHARLES H. STERNBERG.

LAWRENCE, KANSAS.

THE SONG OF BIRDS.

TO THE EDITOR OF SCIENCE: Some time ago Mr. W. E. D. Scott contributed to SCIENCE an article upon the song of birds, drawing the conclusion that when isolated from their kind birds would originate a song.

In the building in which my office is located there is a canary that was taken from its parent bird when quite young, and grew to adult age entirely isolated from other birds. It has developed a song of its own made up, as nearly as I can distinguish, of but three tones sung as a phrase of seven notes. While the song suggests that of the ordinary canary it is not, I would say, actually any part of it; it is sometimes used singly, though generally repeated several times, and there is little if any variation from the original phrase or form.

WALTER S. KELLEY.

THE CONGER EEL.

TO THE EDITOR OF SCIENCE: The U. S. National Museum has recently received from the New York Aquarium a specimen of the larval form of the conger eel, which was captured in Gravesend Bay, N. Y. It measures four inches in length and is in a good state of preservation. Another specimen recently sent to the Aquarium was taken on the New Jersey coast.

Although the adult conger eel is common in New York waters, the *Leptocephalus* form has been recorded but rarely. Brevoort recorded its occurrence in the vicinity of New York City many years ago.

BARTON A. BEAN.

U. S. NATIONAL MUSEUM,
WASHINGTON, D. C.,
April 25, 1902.

CORRESPONDENCE OF THE LATE PROFESSOR LEIDY.

TO THE EDITOR OF SCIENCE: The undersigned has been collecting for some time the correspondence of the late Professor Joseph Leidy. Before the same is published, he would be indebted for any such which may be in the possession of the readers of SCIENCE. Care will be taken to return the originals if requested. Kindly address,

DR. JOSEPH LEIDY.

1319 LOCUST STREET,
PHILADELPHIA, PA.,
April 21, 1902.

SHORTER ARTICLES.

THE HYDROLYSIS AND SYNTHESIS OF ETHYL BUTYRATE BY PLATINUM BLACK.

KASTLE and Lowenhart have shown that the catalytic action of the enzyme lipase is reversible, *i. e.*, that it accelerates not only hydrolysis of fats into fatty acid and alcohol, but also the synthesis of fats from fatty acids and alcohol (*Chemical News*, February 8, 1901–March 15, 1901).

In an investigation on the action of enzymes which I began over a year ago at the suggestion of Professor Loeb, it occurred to us to try experiments with platinum black as the active principle in place of lipase.

I found that platinum black acts quite comparably to lipase. Platinum black hydrolyzes ethyl butyrate as well as synthesizes it from butyric acid and ethyl alcohol.

In my experiments the following chief facts were found:

1. Platinum black hydrolyzes ethyl butyrate, as is shown by the constant and definite increase in the acidity of the solution.

2. The velocity of the action is a function of temperature, *i. e.*, an increase in temperature from 0°C. to 40°C. is accompanied by a correspondingly increased hydrolysis.

3. The velocity of the reaction is a function of the quantity of the platinum black used; but independent of the quantity of ethyl butyrate used.

4. Platinum black synthesizes butyric acid and ethyl alcohol into ethyl butyrate. The odor of ethyl butyrate appears in a short time and increases with the increase in time.

5. The catalytic action of platinum black is diminished through the addition of small quantities of those poisons which, according to Kastle and Lowenhart, interfere with the catalytic action of lipase, *e. g.*, potassium cyanide, hydrogen cyanide, phenol, mercuric chloride, salicylic acid, silver nitrate, chloroform, sodium fluoride and others.

In all the experiments bacteriological precautions were used to exclude the possible influence of bacteria in these results. Control experiments showed that the above hydrolytic and synthetic action did not occur in the absence of platinum black.

My sincere thanks are due Professor Loeb for his helpful and valuable suggestions in these experiments.

A full report of these experiments will appear in the *American Journal of Physiology*.

Hugh Neilson.
Hull Physiological Laboratory,
University of Chicago,
April 12, 1902.

THE JACKSON OUTCROPS ON RED RIVER.

The Jackson stage of the marine Tertiary appears on the Red River in Louisiana at three points, known to the writer from recent inspection. The northernmost outcrop is the well-known long low bluff at Montgomery, which is probably the most extensive and prolific exposure of the stage now existing. The fossils are contained in profusion in a light blue-gray argillaceous marl, the bed being some six feet in thickness and having a very pronounced even dip, through the approximately quarter mile of exposure, of about one foot in fifty along the straight course of the river, which is here nearly due south, until it disappears beneath the surface at low water.

The next exposure occurs about a mile and a half below the Montgomery outcrop, on the estate of Mr. T. W. Kimbrel. These beds, which are also exposed along a line bearing but a few degrees east of south, have so slight a dip that they appear to be practically horizontal to the eye and are composed for the greater part of greenish-black and brick-red clays. This deposit is not so rich in species as the Montgomery bed and is much more limited in horizontal extent; it bears nearly due south from the Montgomery bed.

The third exposure occurs at the eastern base of the high and very picturesque bluff, more than a mile in length, about three miles below the Kimbrel beds and limiting the estate of Mr. John Young, and is in like manner composed of blackish and red clays; it bears about thirty degrees south of east from the Kimbrel deposits and may be known as the Young's Bluff bed. Both the Kimbrel and Young's Bluff beds are characterized by a profusion of a large *Pinna* and of *Venericardia planicosta, Volutilithes* and *Pseudoliva.*

The Kimbrel bed belongs to a horizon noticeably distinct from the Montgomery outcrop and contains immense numbers of an extremely minute *Lucina,* which is without doubt one of the smallest known bivalves. It is suborbicular, generally a little higher than long, slightly inequilateral, with the posterior side more broadly rounded than the anterior, strongly inflated, thick and heavy in substance, with the hinge thick and strong, all the cardinal teeth large, and the lateral teeth also very thick and almost equidistant from the cardinal. The beaks are small and moderately elevated, the lunule long, narrow and rather ill-defined. The ventral edge is crenulate within and the exterior surface marked with feeble close-set lines of growth and generally also three or four deep concentric grooves of arrested growth. The length of the largest valve in an extended series is 1.35 mm., the height 1.4 mm. It may be called *Lucina atoma,* and is brought forward with a name at the present time because of its importance in being the characteristic fossil of the Kimbrel horizon.

It is impossible at present to state the number of feet of strata separating this horizon from the Montgomery, for it is probable that the latter stratum changes its dip shortly after disappearing below low water, but there are several changes in the nature of its fossils that indicate considerable lapse of time. This is shown, for example, in *Venericardia planicosta,* in which the hinge seems to be less developed and the substance of the entire shell thinner, and in *Volutilithes,* where the columella usually has two folds instead of the three which is the prevailing state at Montgomery. These differences also hold good with the same species as found in the Young's Bluff bed, which must be very nearly synchronous with the Kimbrel bed, but the former is nevertheless sufficiently distinct in horizon to have developed another characteristic species of *Lucina,* occurring there very abundantly. It is also very minute, though a little larger than *atoma* and may be named *perminuta.*

This species is suborbicular, generally a little longer than high, less inflated than *atoma* and much thinner in substance, similarly inequilateral and more broadly rounded behind, with the lunule much deeper and more evident and only slightly more than twice as long as wide. The hinge is much thinner and the lateral teeth are similarly placed, but much weaker. The ventral edge is similarly crenulate and the external surface has much more evident close-set and sublamelliform lines of growth, the deep grooves of arrested development, when present, being generally limited to the ventral portions. The length of the largest valve before me is 1.55 mm., the height 1.45 mm.

It is probable that these two species, together with such forms as *smithi* and *choctavensis,* should be considered generically distinct from *Lucina.*

The bed at Montgomery contains myriads of the very small pelecypod *Alveinus minutus,* which may be considered one of its characteristic species when comparing it with the upper horizons, but no example of *Kelliella bœttgeri* Meyer—characteristic of the deposits at Jackson, Miss.—or of the two minute Lucinæ, characterizing the overlying Kimbrel and Young's Bluff beds, could be found. In the Kimbrel deposit *Alveinus minutus* becomes extremely rare and one specimen of the *Kelliella* was obtained. Neither could be found in the Young's Bluff outcrop, although this was not so thoroughly examined.

In venturing upon a suggestion of correlation with the beds at Jackson, Miss., it seems proper to consider the Montgomery outcrop as virtually synchronous with the Dry Creek deposit, and the Kimbrel bed as well above the Moody's Branch beds. The Young's Bluff bed is still higher, but neither seems to have developed any of the purely Red Bluff species, although lithologically they both appear to be somewhat similar to that well-known deposit in Mississippi. As these greenish-black clays are however similar to those which also characterize so much of the Lower Claiborne in Louisiana, very little can be inferred from such resemblances. In fact, lithological characters stand for very little in the strata of the southern Tertiary, except in a few instances and the paleontological are the only ones that can generally be depended upon.

THOS. L. CASEY.

ST. LOUIS, MISSOURI,
March 11, 1902.

THE NOMENCLATURE OF THE MONOPHLEBINE COCCIDAE.

WORKING over the Monophlebinæ for Wytsman's 'Genera Insectorum,' I find myself able to recognize six genera out of about fifteen which have been proposed. These are *Monophlebus, Stigmacoccus, Lophococcus, Palæococcus, Walkeriana* and *Icerya.* At present I am unable to separate *Crypticerya* from *Palæococcus* and the latter is connected by lately discovered forms with *Walkeriana,* so that it becomes difficult to indicate sharp generic limits. These insects are very widely distributed and ancient forms, going back at least to the Tertiary, one species occurring fossil at Florissant.

Mr. Newstead, in describing *Walkeriana pertinax* (P. Z. S., 1900, p. 948), says he at one time 'thought the insect might form the type of a new genus under the name *Aspidoproctus,*' but has decided for the present to leave it in *Walkeriana.* Now this creature forms at least a good section or subgenus for which we need a name. I am taking up *Aspidoproctus,* as of Newstead, but am a little uncertain whether I have the right to do it. I should like to have the opinion of other naturalists, whether a name introduced as cited is to be regarded as published. *Gymnococcus* Douglas was introduced in the same way and is now current.

Some other new sections have been found necessary. *Mimosicerya,* with 9-jointed female antennæ, includes *Palæococcus hempelæ* (Ckll.). *Monophlebulus* with 7-jointed female antennæ, includes *Monophlebus fuscus* Maskell. The Linnean *Coccus cacti* becomes *Monophlebus cacti*. Maskell's supposed *Monophlebus burmeisteri* from Japan (*Trans. N. Z. Inst.*, XXIX., p. 237) becomes *M. maskelli* and belongs to the section *Drosicha.*

T. D. A. Cockerell.

SCIENTIFIC NOTES AND NEWS.

A reception in honor of Lord and Lady Kelvin was given at Columbia University on the evening of April 21. Over 2,000 guests were present, including many eminent men of science. Professor F. B. Crocker presided, and addresses of welcome were made by President Nicholas Murray Butler on behalf of Columbia University, by Professor Elihu Thomson on behalf of the Institute of Electrical Engineers, by Professor A. G. Webster on behalf of the American Physical Society, and by Professor R. S. Woodward on behalf of the American Association for the Advancement of Science and other societies. Lord Kelvin replied in an address about half an hour in length, in the course of which he referred to his several visits to America and the great progress that had been made by this country in the applications of electrical science. Lord Kelvin is expected to visit Cornell University on May 2, where he will address the students and attend a reception given by Dr. R. H. Thurston, dean of Sibley College. Lord Kelvin appeared before a congressional committee on April 24, to advocate the bill introducing the metric system of weights and measures.

Mr. M. H. Saville will return to New York in May after a successful winter's work of excavation in the Zapotecan tombs of Cuilapam near Oaxaca, with the Loubat Expedition of the American Museum of Natural History.

President A. S. Draper, of the University of Illinois, has in view of his illness been given leave of absence by the trustee.

Professor F. L. Washburn, of the University of Oregon, has been elected state entomologist of Minnesota, succeeding the late Otto Lugger.

The Board of Health, New York City, has increased the salary of Dr. Hermann M. Biggs from $2,500 to $5,000 per year, and changed his official title from director of the bacteriological deparment to medical officer.

Commissioner Lederle, of the Board of Health of New York City, has given out the following appointments to honorary officers: Daniel Draper, Ph.D., consulting meteorologist; George Henry Fox, dermatologist; Stevenson Towle, sanitary engineer; Clarence C. Rice, M.D., laryngologist; Arthur B. Deuel, M.D., attending otologist, and George F. Schrady, M.D., consulting surgeon.

Dr. Charles K. Mills, professor of nervous diseases in the University of Pennsylvania, gave a dinner at the University Club, Philadelphia, on April 13, in honor of Dr. William Aldren Turner, of London, the neurologist, and his brother, Dr. Logan Turner of Edinburgh, the laryngologist. They are the sons of Sir William Turner, the eminent anatomist of the University of Edinburgh.

Letters have been received from Mr. Harry de Windt, who is attempting to make a land expedition across Bering Strait. At the end of February he was on the upper Yana River, six hundred miles north of Yakutsk.

Mr. S. M. Vauclain, General Superintendent of the Baldwin Locomotive Works adelphia, and inventor of the Vauclain Compound Locomotive, lectured before the engineering societies of Lehigh University on Thursday evening on 'The Locomotive.'

The committee of the Medical School of the Johns Hopkins University, appointed to erect a memorial to the late Dr. Jesse William Lazear, who lost his life as the result of an experiment on the transmission of yellow fever, reports that sufficient money has been subscribed to erect a memorial tablet and to establish a library fund for the purchase of works relating to tropical diseases.

J. Sterling Morton, ex-Secretary of Agriculture, died at his home at Lake Forest on April 27.

M. ALFRED CORNU, the eminent physicist, since 1867 professor at the École polytechnique, Paris, has died at the age of sixty-one years.

THE American Mathematical Society, at its recent meeting in New York City, authorized the establishment of a section of the Society on the Pacific coast. It is expected that the new section will be organized at San Francisco on May 3.

THE Royal Geographical Society, London, has established a gold medal for geographical research, to be called the Victoria medal. The first award has been made to Mr. E. G. Ravenstein for his work in scientific cartography, and especially for his map of east central Africa.

THE Catalonia Academy of Medicine, at Barcelona, offers a prize of about $500 for the best essay on the comparative histology of the fovea centralis, to be received before the end of the present year.

THE marine laboratory which the Prince of Monaco has built at Monaco is now nearly complete, and will soon be ready for use. It is understood that naturalists of all nationalities will be welcomed to work at the laboratory and that the equipment will be very complete.

MR. ANDREW CARNEGIE has informed the mayor of Stratford-on-Avon that he will defray the total cost of a library and reading-room for the town if the corporation will provide a suitable site.

WE have already noted the bill before Congress appropriating $10,000 to establish a biological station on the Great Lakes. Professor Jacob Reighard, to whom the movement is chiefly due, writes as follows in regard to the importance of the station:

The purpose of such a station would be as follows: (1) The investigation of the problems connected with the fisheries of the Great Lakes throughout their extent. Such work should be largely experimental like that of the agricultural experiment stations. These problems are:

(*a*) Breeding times, places and conditions of the fishes.

(*b*) Food, feeding habits, feeding grounds and the migrations of the immature and adult commercial fishes.

(*c*) The enemies of the commercial fishes.

(*d*) Special studies of the whitefish and sturgeon, which are decreasing and of the carp which have been recently introduced and enormous increase of which appears a serious problem and is a possible danger to the other fishes.

(*e*) A careful study of the general biological conditions surrounding the fishes and which appear to be favorable for their growth and development.

Such work is a necessity not only for successful artificial propagation but for a proper framing of suitable fisheries laws. Such work should be carried on year after year in connection with the regular work of the United States Fish Commission, for the reason that it is not only germane to its investigations but essential to the success of its operations and to the prosperity and increase of the commercial fisheries. Just as the National Government supports large numbers of experimental stations in the interests of agriculture, so should it support such a station in the interest of fish culture, an *aquacultural* experimental station.

MRS. C. P. HUNTINGTON and Archer M. Huntington, Esq., have provided liberally for the continuation of the work begun in 1899 by the Anthropological Department of the American Museum of Natural History, New York, among the Indians of California, through the liberality of Mr. Collis P. Huntington. Some of the results of the work already accomplished by the Huntington expedition among the California Indians have been published this winter in the *Bulletin* of the Museum by Dr. Roland B. Dixon. The 'Basketry Designs of the Indians of Northern California' is the title of the first of the series of publications issued by this expedition.

DR. EDGAR A. MEARNS, Surgeon U. S. Army, to whom the Museum is already indebted for many thousand specimens, has recently donated to the department of conchology a large series of specimens illustrating the littoral molluscan fauna of the vicinity of Newport, Rhode Island. Through the generosity of Percy R. Pyne, Esq., the Museum was enabled in March to purchase two unpublished paintings of birds by John J. Audubon. The subjects of these paintings are the Myrtle Warbler and the Red-Eyed Vireo.

Mr. J. C. Stevens, the London auctioneer, sold on April 14 the entomological and scientific library of the late Miss E. A. Ormerod, and on April 15 and 17 parts of the collections of butterflies and birds' nests and eggs formed by the late Philip Crowley.

The American Congress of Tuberculosis will meet in New York City at the Hotel Majestic, on May 14, 15 and 16.

The Second International Congress for Electricity in Medicine and Radiography will be held at Berne from September 1 to 6, 1902.

The Astronomical Society of France held its annual meeting on April 12, under the presidency of M. H. Poincaré, who made an address on the progress of astronomy during the year 1901.

The New York *Evening Post* quotes as a serious piece of news the following from a London Journal:

"Another American marvel, though in a totally different direction, is Will Gwin, the boy surgeon. Before he could walk he was present at all the operations his father—himself a clever surgeon—undertook, and not long ago he gained his certificate at the New Orleans University, the examiners stating that he was the cleverest osteologist they had ever met. Though only six years of age, he is consulted by patients whose age is ten times his own, and his income runs well into four figures."

UNIVERSITY AND EDUCATIONAL NEWS.

Mr. John D. Rockefeller has given $1,000,000 to promote the cause of southern education. It is understood that it will be distributed among educational institutions by the Southern Educational Conference, newly organized by Mr. Robert C. Ogden, of New York City.

Plans have been completed for the new buildings of the College of the City of New York to be erected on Amsterdam Avenue and 138th and 139th Streets, at a cost of $2,100,000. Five buildings are planned, including a mechanical arts building and a chemical laboratory.

Amherst College has received a gift of $15,000 for the endowment fund, the income of which is to be used to increase the salaries of instructors and associate professors.

The committee of the corporation of Harvard University appointed last December to report on the University Library has recommended the construction of a new library building to cost about $650,000.

The department of geology of Cornell University will conduct field work for ten weeks, the headquarters of the school being in the Helderberg mountains, near Albany.

Mr. W. C. Bray, of the University of Toronto, has been awarded the '1851 exhibition traveling scholarship' for research in chemistry.

Dr. Raymond Dodge, associate professor of philosophy at Wesleyan University, has been appointed professor of psychology.

Dr. James Locke, of Yale University, has been called to an assistant professorship of chemistry in the Massachusetts Institute of Technology.

Mr. M. de K. Thompson, assistant in the Rogers Laboratory of the Massachusetts Institute of Technology, has been appointed instructor in electro-chemistry, with leave of absence to study abroad.

A two years' course in pharmacy and a four years' course in pharmaceutical chemistry have been added to the college curriculum of North Dakota Agricultural College. Mr. Charles H. Kimberly, of Ohio University, has been elected instructor in pharmacy. Miss Marie B. Senn, professor of domestic science, resigns at the close of college year.

Dr. Uhlig has been appointed professor of physiology in the University at Vienna, and Dr. Haussner, of Giessen, professor of mathematics in the Technical School at Karlsruhe. Dr. Max V. Vintschagau, professor of physiology in the University at Innsbrück, has retired.

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, MAY 9, 1902.

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*THE ORIGIN OF SPECIES BY MUTATION.**

FORTY years ago Darwin's 'Origin of Species' was given to the world. The number of those who witnessed its appearance gradually diminishes year by year. Few are left to remember the condition of things at that period, and the shock which its publication caused. We had grown up firmly convinced of the invariability of species. The precepts and commands of Linnæus reigned supreme over our thoughts and deeds alike. To take the last specimen from a locality, no one would have dared, not even in the seclusion of the forest primeval. Far less would any one have had the temerity to give even a single thought to those phenomena whose study he had forbidden. Many an interesting variation did I meet with on my walks when a student, but, obedient disciple that I was, left uncollected.

With the appearance of Darwin's book came the complete overthrow of the old doctrine. What formerly had been *the* science now became merely its primer. New demands were made upon investigation, interest was now directed into entirely new channels. An endless field was

* Address before the second general meeting of the eighth congress of the 'Nederlandsche Natuur- en Genuskundige Vereeniging,' held at Rotterdam. Translated from the 'Album der Natuur,' Mei, 1901, by H. T. A. Hus, Assistant in Botany, University of Amsterdam, and revised by the author.

opened for thoughts, for observation, or comparison and the drawing of conclusions. The result was a hard-fought war, openly carried on against Darwin, and ending in his complete victory. But before we were able to declare ourselves advocates of the new doctrine, the bonds which held us were to be severed, and we had to break loose from the old prejudices.

Of the present generation none have known this internal struggle. They have been brought up in the new doctrine. The common descent of species and genera is for them a dogma, as much as the creation of species was for their fathers. With different eyes they watch the progress of science in this new territory. They neither feel the pride of the victor, nor have they the personal example of Darwin's untiring labor. It is much to be regretted that everywhere, in the manner of both working and thinking, we find evidence of this. Deductive treatment has taken the place of observation and investigation. An immense superstructure of speculative science has risen on the foundation of Darwin's selection theory. The possible influence of selection in past times has been discussed for numerous cases, but its actual influence at the present time was left uninvestigated. Thought, instead of Nature, became the source of theory, and the latter consequently became farther and farther removed from the truth.

At last the tide is turning. Conn, in a recent book on evolution, exclaims: 'Let us leave our books and return to Nature,' adding, 'leave speculation and turn to observation.' The necessity of this is making itself felt everywhere. The time of contemplation is past. We no longer ask how things *might be;* how things *are* is the question of the hour.

De Varigny, the well-known French translator of Wallace's book on 'Darwinism,' formulates as the first requisite, viz., that we should see species originate. It is no longer sufficient to be convinced that it is so, we must know it from experience. During the last decade a few investigators have sought the paths which lead to this goal. It is but recently that the results they obtained have been published. And though the paths followed are very divergent, and the results differ greatly, yet for all the initial point was Darwin's book; none were influenced by subsequent speculations. Darwin's theory of adaptation led to the investigations on the origin of species in the Alps by Kerner and von Wettstein; Darwin's selection theory to the statistical investigations of variability by Galton and Weldon, and to the mathematical studies of Karl Pearson. And likewise finding its origin in Darwin's great work, stands the study of discontinuous variability, the study of the single variations or mutations,* and the question whether in these must be sought the origin of species.

Only a single case has been discovered in which it is possible to actually see species originate; and this not accidentally, but experimentally, so that one can watch and carefully follow the manner of their origin.

Three kinds of evening primroses occur in Holland, all three introduced from America about a century ago, but since escaped from cultivation. The youngest of the three, or rather the one most recently introduced, and at the same time the most rare, is the large-flowered evening primrose, described at the beginning of the nineteenth century by Lamarck, and named after him *Oenothera Lamarckiana*. It is a beautiful, freely branching plant, often attaining a height of five feet or more. The

* Sudden variability, comprising the deviations from the rules of heredity in the wider sense, as opposed to fluctuating variability, *e. g.*, the degree of variability peculiar to each character of a species. Hugo de Vries, 'Die Mutationstheorie.' Leipzig, Veit & Co. 1901.

branches are placed at a sharp angle with the erect stem and in their turn bear numerous side branches. Nearly all branches and side branches are crowned with flowers, which, because of their size and bright yellow color, attract immediate attention, even from a distance. The flowers, as the name indicates, open towards evening, shortly before sunset, and this so suddenly that it seems as if a magic wand had touched the land and covered it with a golden sheet. Bumble bees and moths, especially those of *Plusia gamma* and of *Agrotis segetum*, are the principal visitors. During the hot weather the flowering period is limited to the evening hours. In daytime often nothing is to be seen but faded and half-faded flowers and closed buds. Each flower bears a long style with four or more stigmas, which protrude at some distance above the eight anthers, and would therefore, as a rule, not be fertilized without the help of insects. When the flowers, including their apparent stem, the calyx tube, drop off, there remains behind a perigynous ovary, which finally becomes a capsule. At first green, it becomes brown on ripening and finally opens with four valves, setting free the seeds. A stem with ten to twenty, or even thirty or forty, capsules is not rare, nor consequently a plant with a hundred or more fruits. And since each fruit contains more than a hundred seeds it would be quite possible for a plant of this species to reproduce itself several thousandfold, provided all seeds could germinate and grow.

It is this plant, *Oenothera Lamarckiana*, which exhibits the long-sought peculiarity of producing each year a number of new species, and this not only in my experimental garden, but also when growing wild. But in the latter case the new species have as a rule but a very short lease of life; they are too weak and too few in number to survive in the struggle for existence with the hundreds and thousands of their fellows. In the experimental garden, however, they can be recognized at an early stage, and with especial care may be isolated and cultivated. It is thus that in the experimental garden we are readily able to see that which, among wild-growing plants, is lost to observation.

The new species vary but little from the old. An inexperienced eye detects no difference. Only a careful comparison shows that here we have to deal with a new type. There are some, for instance a dwarf species, and species with a peculiar close crown (*O. nanella* and *O. lata*), which at once attract our attention, because they are short of stature. Again, some are more slender and delicate, others low and unbranched, or robust and tall. A difference may be detected in the shape of the leaves, their color and their surface. The fruits vary in the same manner; sometimes they are long, sometimes short, sometimes slender, sometimes stout. The more one observes these plants, the more differences one sees. Gradually it becomes apparent that here we have to deal, not with a chaos of new forms, but rather with a series of sharply defined types. Each of these types originated from a seed produced by the parent species, growing wild, and fertilized in the usual manner, or growing in the experimental garden, and fertilized artificially, with its own pollen.

Here then we have our first result. The new species originate suddenly, without preparation or intermediate forms. But they do not differ from the old species like an apple from a pear, a pine from a spruce, or a horse from a donkey. The deviations are far smaller. But every one knows how difficult it is to distinguish the common oak from *Quercus sessiliflora*, or the lime tree from *Tilia grandifolia*. Yet these are forms which by the disciples of Linnæus are recognized as true species. And what botanist has not been entangled in the species of *Hieracium,* or who is able to recognize at first sight the closely related forms of *Cochlearia?*

Because of the dying out of intermediate forms, more ancient species may be widely separated. On the other hand, more recent species, whose ancestors are still alive, may form narrow groups because of and with these surviving ancestors. Good illustrations of the latter are yielded by roses, willows and brambles, as shown by the facility with which the closely related forms can be cross-fertilized, as well as by the great trouble the numerous bastards cause in determination. Such genera are found everywhere in the plant kingdom; the gentians of the Alps, for instance, or the *Helianthemums,* which with us seem to be composed of fairly distinct types. Everything indicates that in these cases the species are of more recent date, and that only through the dying out of intermediate forms the differences between the remaining ones have attained that degree of distinctness which so greatly facilitates the separation of the other groups.

In this regard the *Oenotheras* agree exactly with what may be observed in nature. Recent forms group themselves around the mother form with minute, hardly perceptible gradations.

Once formed, the new species are as a rule at once constant. No series of generations, no selection, no struggle for existence are needed. Each time a new form has made its appearance in my garden, I have fertilized the flowers with their own pollen and have collected and sown the seed separately. The dwarf forms produce nothing but dwarfs (*O. nanella*), the white ones nothing but white ones (*O. albida*), the *O. gigas* nothing but *O. gigas,* the red-nerved ones nothing but corresponding specimens. But a single form made an exception. This was the small *O. scintillans,* the seeds of which produced but a percentage of *scintillans* plants, but here this inconstancy is and was as much the rule as the constancy of the other species.

As an example I may cite *O. gigas.* The plant is as tall as *O. Lamarckiana* but has a more robust stem, denser foliage, a broader crown of large, widely opening flowers and stouter flowering-buds. The fruits attain but one half the length of those of plants of the mother species and consequently contain fewer seeds. But the individual seeds, on the other hand, are rounder, fuller and heavier. This type originated in my cultures of 1895 as a solitary specimen, which at first was overlooked. At that time I desired to hibernate some plants, and in the latter part of the autumn chose for that purpose twelve of the strongest and best developed. It was only in the following summer, when the plants began to flower, that I noticed that one plant showed differences, the importance of which I did not fully realize until the fruits, on ripening, became much shorter and stouter than ordinarily was the case. It was only then that I placed the raceme in a bag so as to prevent fertilization with other pollen. Afterwards this seed was collected separately and in the spring of 1897 sown in a flower bed between other beds sown with seeds of the normal *Oenothera Lamarckiana.* Immediately subsequent to germination no difference was apparent, but when the third and fourth leaves unfolded it suddenly became evident that a new species had originated. All plants differed from their neighbors, were more robust and bore broader, darker leaves. Though two to three hundred in number, all evidently belonged to one distinct type. Not having, at the time, paid special attention to the mother plant, I was unfortunately unable to compare the latter with the type at this age. But when, during the summer, first the stems and afterwards the flowers and the fruits, made their appearance, the agreement became perfect. All specimens closely resembled the mother, and together they formed the new species, *Oenothera gigas*. This species therefore was at once constant, even though it found its origin in but a single specimen. Evolved with a sudden leap from the mother species, differing from it in general appearance as well as in the character of its various organs, it remained unchanged. It was no rough cast which selection had to correct and polish before it could represent a distinct form; the new type was at once perfect and needed no smoothing, no correction.

My other species originated in the same manner, suddenly and without transitions. We may therefore assume that species, when growing wild, do not appear gradually, slowly adapting themselves to existing conditions, but suddenly, entirely independent of their surroundings. Species are not arbitrary groups, as Bailey, and with him many others, believed should be deduced from the theory of descent, but sharply defined types, unmistakable, for one who has once seen them.

Each species is an individual, says Gillot, having a birth, a lease of life, and an inevitable death. From the moment of birth until the time of death, it remains the same. Only when taking this point of view can we reconcile our daily experience of the constancy of species with the theory of descent. This is fully confirmed by the results of my experiments.

If species originated gradually, in the course of centuries, their birth could never be observed. Were it so, this most interesting phenomenon would forever remain hidden from us. Happily it is not so. Each species as soon as born takes its place as peer in the ranks of the older species. This birth may be directly observed. One can even collect the seeds in which the new types are hidden, and one can observe the first steps in the development of these types. Literally the new species originates at the time of the formation of the seed, but it is born only at the time of germination. But at this period it is not recognizable as such; this only becomes possible after the first leaves have unfolded. The plant can then be photographed, and in this manner we may preserve the type as soon as it becomes discernible and recognizable. In fact, one can study the birth of a species as readily as that of any individual, be it plant or animal.

Yet it shows one important difference. It is not at all necessary that a species should originate in but a single specimen as we saw in the case of *O. gigas*. The same leap, the same mutation may occur again, and actually did so in my experiments, where, in fact, it seemed to be the rule. All that is required is that the cultures consist of some thousands instead of some hundreds of specimens. Two things then become apparent: First, that in each lot several specimens of *O. nanella*, *O. lata*, *O. oblonga* and of certain other new species appear; secondly, that it is only a few types (and no others) which make their appearance. The number of new forms is far from unlimited. On the contrary, but few types make their appearance annually, and this among a large number of specimens. There are some that are more rare, as for instance *O. gigas* and a most graceful, small-flowered mutation which put in an appearance during the past year. In the latter, unfortunately, the seeds did not ripen, and therefore, for the present at least, it has disappeared, leaving no trace, with the exception of a plate, a few photographs and some alcoholic material.

To give a general view of the whole course of my experiments on mutation in this genus, I might combine them in the form of a

Genealogical Tree of Oenothera Lamarckiana.

Generations:	*gigas*	*albida*	*oblonga*	*rubrinervis*	*Oenothera. Lamarckiana*	*nanella*	*lata*	*scintillans*
8th Generation, 1899 Annual.		5	1		1700	21	1	
7th Generation, 1898 Annual.			9		3000	11		
6th Generation, 1897 Annual.		11	29	3	1800	9	5	1
5th Generation, 1896 Annual.		25	135	20	8000	49	142	6
4th Generation, 1895 Annual.	41	15	176	8	14000	60	63	1
3d Generation, 1890–1891 Biennial.				1	10000	3	3	
2d Generation, 1888–1889 Biennial.					15000	5	5	
1st Generation, 1886–1887 Biennial.					9			

O. Lamarckiana forms the main stem; all other species originated from its seeds. Descendants of the mutations are not included in the scheme, so as not to make it too intricate.

The first two generations showed but comparatively few types. The reason for this may be sought in the fact that at the time I did not know how to trace them. Hence the fourth generation shows a marked improvement, which continued after the sowing had undergone a great numerical reduction.

O. oblonga appeared by hundreds. All of these plants closely resembled each other. They could be recognized as rosettes of root leaves by the narrow leaves with broad veins, and later on by their delicate, stiff, nearly unbranched, seemingly naked stems. The same is true for the dwarf forms. Our genealogical tree shows of these about 150; in other experiments I have met with even larger numbers. These plants again form a distinct type, which could readily be recognized, whatever the age of the specimens. *O. rubrinervis, O. albida* and *O. scintillans* were far rarer, but as a rule appeared each year, always bearing exactly the same character.

A species therefore is not born only a single time, but repeatedly, in a large number of individuals and during a series of consecutive years.

It is clear that this fact, so apparent in my experiments, must be of enormous importance in the case of wild-growing plants. How small is the chance of a single plant to triumph in the struggle for existence! Only when a number, or rather a large number, of similar individuals do battle together for the same cause is it that this chance acquires a value. *O. gigas* would have been nipped in the bud were it not for my aid. I have never found it growing wild, as I did some specimens of the less rare *O. lata,* and *O. nanella.* But these also meet with too many hardships. Only once have I found a single specimen in flower.

But next to the question of the more or less frequent appearance of a new species stands another which has as potent an influence upon its life. It is of course a matter of pure chance whether a mutation is or is not better adapted to the environment than the parent species. Sometimes it will go one way, sometimes the other, or both may be equally well adapted. Our *O. gigas* and *O. rubrinervis* are, during the flowering period, as robust as the mother species. Perhaps the first is, because of its broader leaves and stouter stem, a little better adapted. Probably both would survive in the struggle for existence if the early stages were not detrimental. *O. albida* and *O. oblonga,* on the other hand, are extremely weak, and it is with great difficulty that they can be persuaded to produce flowers and fruit. When growing wild they could never survive, in fact, they are never met with, though in the garden experiments they made their appearance in large numbers. For *O. nanella* the form is an objection, at least, under existing conditions, though were these different, it might prove an advantage. In regard to *O. lata,* which until now I have hardly mentioned, the plants are low, with a limp stem, bent tips and side branches, all very brittle, but with dense foliage and luxuriant growth. But unlike its relations, it possesses no pollen. It is true there are apparently robust anthers, but they are dry, wrinkled and devoid of contents. Only by cross-fertilization can *O. lata* produce seeds, and so it is unfit to found a wild type. Certain structural characters of this plant are therefore detrimental, or at least useless, and 'useless characters,' as every one knows, were among the earliest objections to the doctrine of the gradual origin of species by selection. For this theory can explain none but useful characters.

These observations are also important from another point of view. They teach us that the variability of species is independent of environment. This hypothesis, already formulated by Darwin, and which for him was the basis of a simple, logical explanation, is fully confirmed by the results of our experiments. Before Darwin published his 'Origin of Species,' it was generally believed to be otherwise; it was thought that environment had a direct influence on species. Changes in environment would call forth various needs and these in their turn would cause gradual changes in various organs. Use would have a strengthening, disuse a weakening, effect; a functioning in a certain direction would fit the organ better for that function. The changes would take place gradually and imperceptibly, but if only the influence continued long enough in one direction, specific differences would finally appear. On this theory are based the attempts already mentioned to make new species by transporting lowland plants to the highlands and *vice versa.* When this is done, great modifications may be observed, even during the first year. In the Alps the plants assume the compact, woody, small-leaved form which we meet with there so frequently; in the plains they are tall, with slender stems and ample but delicate foliage. At first it appears as if these experiments bore out the general opinion, but Bonnier has shown the opposite. He has proved that it is nothing but adaptation, something which any plant can show and which stands in no relation to heredity and the origin of species.

In my experiments the mother species mutates in all directions, in nearly all organs and characters as well as for better or worse. These changes occur, as far as could be learned, on a poor sandy soil as well as on heavily manured garden soil, with careful treatment and plenty of room between the plants. The mutation therefore is independent of environment, its direction is not governed by circumstances. Numerous species originate at the same time, forming a group in the same manner as the above-mentioned genera. The question which of these will persist in the wild state, which, as legitimate species, will some time form part of our flora, does not concern us at present. This can only be decided when the new forms have lived next to the others for a prolonged period, as some of them have done for the last fifteen years. For sooner or later must begin the struggle for existence, and the species which is best adapted will come out triumphant. But it is not a struggle between individuals, as is commonly believed, but war between species. The question is whether *O. gigas* or *O. rubrinervis*, or perhaps *O. nanella* or some other species will be best adapted to the new environment. Only then will be decided which shall remain and which shall go.

Here we have elimination of the weak, selection of the strong. 'Many are called but few are chosen.' In Nature this is true of species as well as of individuals.

The development of the entire plant kingdom points to a gradual progress. Nature passes from simple to complex, from generalities to particulars, from the lower to the more highly organized, from species with few characters to those which possess a countless number. Are our mutations a step forward in this direction? I believe I am able to answer this question in the affirmative, if we except perhaps *O. lata*, which possesses feminine characters only, and the dwarf forms, whose type is too common.

It is exactly because of this peculiarity that I arrive at this conclusion. Dwarfs constitute the only type which is also met with among other species, a type which is found among a large number of plants, such as dahlias, chrysanthemums, ageratums and a long list of species belonging to the most widely divergent families. A dwarf form is therefore nothing new, it is but an old principle under a new guise. The same is true for so many other forms which in horticultural and systematic botany are dignified by the name of variety. White varieties are found among most red- or blue-flowered species; with hirsute or thorny species occur nearly as many glabrous or thornless forms. Such repetitions are evidently no progress. They contribute largely to the great variety of Nature, but are usually retrogressive and not progressive changes. And ordinarily they deviate from the species in but a single character, something indicated as a rule by the name.

Quite different from this are the mutations of *Oenothera*. Recognizable as seedlings, as rosettes differing in shape, edge and color of the root-leaves, and later with stems differing in structure and mode of branching, agreeing in the flowers, varying in the fruits, they possess a type entirely their own, a type quite novel. Neither in other species of this genus nor in other genera belonging to the same family, nor anywhere else in the plant kingdom, do we find a *rubrinervis* or an *albida* with all their distinctive characters. Here we have something absolutely new, something entirely original.

My observations constitute but a first step in a new direction. But that direction is the one demanded by the times.

Any advance in our knowledge depends on the possibility of seeing species originate. Of course this does not refer to present species. Such a thing would be as impossible, as absurd, as expecting to witness the birth of an individual already inhabiting the earth. The species living at present are too old. But they may give rise to new ones. There seems to be sufficient reason for suspecting that this is happening at this very moment, and in our immediate surroundings, only we are not aware of it. Such cases must therefore be searched for with great care and patience. Once found, they must be carefully and extensively studied. The one case which I have mentioned here shows sufficiently the great treasure of new facts which lies within our reach. All that is necessary is to overcome the first difficulties.

Not only would such studies aid the theories of science, but they would also be of great advantage to the practical side of life. Our improved agricultural plants may serve as an illustration. According to Hays the produce of entire districts may be increased ten per cent. by the careful and repeated selection of seed. And these results were reached by the aid of old methods, applied during a few years only. How great is the promise of the new methods, with their larger prospects and greater chances.

Next to new races are new species. Let this be the motto of science and practice alike, for the welfare of agriculture as well as for the welfare of man.

HUGO DE VRIES.

UNIVERSITY OF AMSTERDAM.

SIXTH ANNUAL MEETING OF THE NEW YORK STATE SCIENCE TEACHERS ASSOCIATION.

THE meeting was held December 27 and 28 in the Medical College of Syracuse University. The greater part of two half days was given up to the section meetings which are reported at the end of this article. There were also four general meetings. Friday evening was devoted to a dinner and social reunion, an innovation appreciated by all.

The following papers were read and discussed in general sessions:

The Value of Research Work in Education: Professor SAMUEL J. SAUNDERS, Hamilton College, Clinton.

All education which attains its highest ends is of the nature of original research. The power to apply the research method should be raised to as high efficiency as possible before we stand face to face with the problems of life; it should be cultivated during the whole school career. Much of our modern educational effort fails because the pupil does not test his knowledge continuously and learn 'to do by doing.' The research method in science trains the observation, the imagination and the memory. It increases manual dexterity and skill. It forces the student to stand on his own merits and makes of him a vital factor in the promotion of civilization and national prosperity.

The Study of Types: Professor N. A. HARVEY, Chicago Normal School.

A full abstract of this paper is printed in *School Science*, beginning with February, 1902.

The Report of the Committee on 'A standard College Entrance in Botany,' appointed by the Society for Plant Morphology and Physiology. Presented by Professor FRANCIS E. LLOYD, Teachers College, Columbia University.

This report is discussed in a recent number of SCIENCE (page 409).

Symposium, *What ought the high school teacher in each science to know? What ought he to be able to do? What are his opportunities for self-improvement?* Brief speeches by several members and guests.

Report of Progress of the Committee on Stimulants and Narcotics: Presented by the Chairman, Professor IRVING P. BISHOP, Normal School, Buffalo.

The report comprises: I., A comparison of text-books used in medical colleges and in the public schools of the state; II., opinions of the committee regarding the effects of alcohol; III., opinions of educators regarding present methods of teaching physiology; IV., conclusions of the committee from the preceding investigation; V., recommendations of the committee. The report urges that the state law be modified so as to give more freedom to the writers of text-books and the teachers of physiology 'to decide as to the character and content of their teaching.' It urges that less time be spent in trying to teach the physiological effects of alcohol and tobacco, and more time in a treatment of the question from the moral and economic standpoint. The report is signed by Professor Irving P. Bishop, Buffalo Normal School; Dr. Burt G. Wilder, Cornell University; Dr. Gaylord P. Clarke, Syracuse University; Dr. Eli H. Long, University of Buffalo; James E. Peabody, Peter Cooper High School, New York.

Alcohol Physiology in the Public School: Professor W. O. Atwater, Wesleyan University, Middletown, Connecticut.

Professor Atwater, after disclaiming any desire to have his own experiments or any set of experiments taught in the schools, when there is so much of great importance to teach in the way of conclusions, said:

The amount of teaching of temperance physiology and the space given to it should be much less than is required by the legislation of a considerable number of states, including your own. The kind of teaching should be that which agrees most closely with the attested principles of physiological science; that which is both scientifically and pedagogically most reasonable. This, in my judgment, means a material modification of the legislation in many states, and an equally important change in the character of a large amount of the text-book instruction. These changes I believe to be called for in the interests of sound science, sound pedagogy, sound morals and effective temperance reform.

He would have some of the time and space now devoted to alcohol physiology given to the subject of food and nutrition in general, since a large part of preventable disease is due to errors in diet.

Referring to the state laws again, he said: Thus it comes about that we have in the United States a great educational movement which is attempting to build moral reform upon a basis of scientific doctrine which the best scientific authority disapproves.

Perhaps the matter has not occurred to you in just this light before, but is not this a fair statement of the case?

A large and increasing number of men of science are coming to realize that scientific error has found its way into the curricula of the schools and are earnestly considering what shall be done to correct it. A large and increasing number of intelligent and conscientious teachers are coming to feel more and more deeply the harm which comes from what they consider to be false science and wrong pedagogical methods, and are earnestly considering how they may be freed from the responsibility of the teaching and the children in their care may be freed from the harm that it brings. Over and against this is a great body of people, profoundly interested in education and morals, tremendously earnest in their self-sacrificing efforts to promote temperance reform, convinced that the present teaching is called for and proper, and determined that it shall be enforced. There is a clash between physiologists and teachers on the one hand and moral reformers on the other. Both seek the same end. They differ as to method.

After discussing the literature of alcohol physiology, and his own experiments, he presented his conclusions, a few of which follow:

We should not teach that alcohol is a food in the sense in which that word is ordinarily used. We should not teach that it is a poison in the sense in which that word is ordinarily used. We may say, and with truth, that alcohol in large quantities is poisonous, that in large enough doses it is fatal, and that smaller quantities taken day after day will ruin body and mind. But it is wrong to teach our boys that alcohol in small quantities, or in dilute forms in which it occurs in such beverages as wine and beer, is a poison in the ordinary sense of the word. In all that we say on this point we must bear in mind that the intelligent boy knows well, and as a man he will know better, that people have always been accustomed to moderate drinking, as it is commonly called, and yet live in excellent health to good old age. If we tell him that alcohol in small quantities is poisonous in the sense in which he understands the word, he will see that we are exaggerating, that we are teaching for effect, and he will instinctively rebel against the teaching. We may say, and say truthfully, that the moderate use of alcohol is fraught with danger. But the cases where the occasional glass leads to excess are the exceptions. If we present them to the thoughtful boy as the rule or the common result, he will detect the fallacy and distrust the whole doctrine. We may be right in saying that alcohol often does harm to health when people do not realize it, that it prepares the system for inroads of disease, that there is a graduation of injury from forms scarcely perceptible to the utter ruin of body and soul. But to present the 'horrible examples' as a common result of drinking is illogical in itself, contrary to right temperance doctrines, and hence injurious to the children we teach. For that matter I believe the picturing of the frightful results of vice to young and innocent children is more harmful than useful. We ought not to teach that alcohol in small quantities is harmful. Still more should we avoid saying that it is commonly beneficial. Some of us as individuals may believe that its use in small quantities is generally desirable, but there is nothing in either the facts of common experience or in the results of scientific inquiry to justify the inference as a general principle. It is under some circumstances a valuable nutriment in the sense that it can yield energy to the body, but not in the sense that it can build tissue. It is under other circumstances a poison in the sense that it is injurious to health. When taken in large enough quantities and for long enough time it is destructive to life. It is sometimes very useful and sometimes very harmful, but the harm that comes from drinking, in many communities, vastly exceeds the good.

While we cannot deny to alcohol a nutritive value, that value is very limited. In yielding energy to the body, it resembles sugar, starch and fat, though just how and to what extent it resembles them experimental inquiry has not yet told us. It differs from them in that it does not require digestion and is hence believed to be more easily and readily available to the body. It is not stored in the body for future use like the nutrients of ordinary food materials. The quantity that may be advantageously used is small. If large amounts are taken, its influence upon the nerves and brain is such as to counteract its nutritive effect and it becomes injurious in various ways. And finally there are many people who begin by moderate use and are led to disastrous excess. Alcohol may be useful to one man and harmful to another. One may take a considerable amount without apparent harm while another may be injured by very little. One may use it habitually without injury, while another may not. In sickness it may be a priceless boon, but it may likewise be the cause of physical, mental and moral ruin. The boy or the man, as long as he is in good health and does not need alcohol or medicine, is in general better off without it.

In speaking of the Connecticut school physiology law, the speaker said, in substance:

The last Connecticut Legislature repealed the former law, which, though less objectionable than those of some other states, including New York, was felt by nearly all the leading educators in Connecticut to be too stringent. It was replaced by one which requires temperance instruction in a smaller number of grades, none being called for in either the primary grades or the high school, and leaves the character of the text-book and the kind and amount of instruction wholly to the decision of the school authorities. This change was brought about by a fortunate cooperation of the teachers and temperance organizations of the state, including the state branch of the Woman's Christian Temperance Union; though it was vigorously opposed by Mrs. Hunt of the Department of Scientific Temperance Instruction of the National W. C. T. U. The speaker believed that the example of Connecticut might well be followed in New York and other states.

In conclusion, Professor Atwater said: We wish to help the drunkard to reform; but is it necessary to tell him that no man can touch alcohol without danger? To build up the public sentiment upon which the reform of the future must depend, we wish our children to understand about alcohol and its terrible effects; but when we teach them in the name of science shall we not teach them the simple facts which science attests, and which they can hereafter believe, rather than exaggerated theories, whose errors, when they learn them, will tend to undo the good we strive to do? In short, is not temperance advisable, even in the teaching of temperance doctrine?

In the great effort to make men better, there is one thing that we must always seek, one thing we need never fear—the truth.

After a long and animated discussion, in the course of which the statements of Dr. Atwater and the committee were challenged by Mrs. Mary Hunt, of the National W. C. T. U., and a number of her followers, the report of the committee was adopted and the committee was requested to continue its work for another year.

The following are the officers for this year: President, Professor William Hallock, Columbia University; Vice-President, Professor Howard Lyon, Oneonta Normal School; Secretary-Treasurer, A. R. Warner, Auburn High School. Executive Council, Professor Edward S. Babcock, Alfred University; Professor H. J. Schmitz, Geneseo Normal School; William M. Bennett, Rochester High School; Professor James H. Stoller, Union University; Principal Thomas B. Lovell, High School, Niagara Falls; Professor W. C. Peckham, Adelphi College, Brooklyn; Professor A. D. Morrill, Hamilton College; Professor E. W. Wetmore, State Normal College, Albany, N. Y.; Professor H. R. Linville, Boys' High School, New York City; Mr. Charles N. Cobb, Regent's Office, Albany; Professor J. H. Comstock, Cornell University, Ithaca; Professor E. R. Whitney, Binghamton High School.

Franklin W. Barrows.

SECTION OF PHYSICS AND CHEMISTRY.

This Section was in charge of Professor J. M. Jameson, Pratt Institute, Brooklyn, N. Y. Two sessions were held and each was well attended. At the session on Friday afternoon, December 27, 1901, Professor Charles B. Thwing, Syracuse University, read a paper on 'The Preparation and Training of the Teacher of Physics,' and Dr. Lyman C. Newell, State Normal School, Lowell, Mass., read a paper on 'The Preparation and Training of the Teacher of Chemistry.' Professor Thwing emphasized the necessity of broad and accurate training in physics and a wide knowledge of the salient points of contact of the other sciences with physics. Dr. Newell dwelt upon the need of a better knowledge of the fundamental facts of chemistry, the desirability of original work, and the necessity of more attention to the application of psychology to the laboratory work. At the session on Saturday morning, December 28, 1901, Mr. J. R. Kittredge, Union Classical School, Schenectady, N. Y., read a paper on 'The College Entrance Preparation of Students as Viewed from the Secondary Man's Standpoint.' Professor Charles M. Allen, Pratt Institute, Brooklyn, N. Y., discussed 'Chemical Laboratory Notes,' and Mr. F. M. Gilley, High School, Chelsea, Mass., read and illustrated a paper on 'How to Meet the Problem of Teaching Physics by the Laboratory Method in Secondary Schools.' Mr. Kittredge made a plea for a four years' course in science with physics as the basis, Professor Allen illustrated his plan of presenting experiments and recording notes by the 'loose-sheet method,' and Mr. Gilley by two experiments illustrated his method of teaching a large section as a whole. The papers were discussed by the members of the Section, and a healthy interest was shown in the one thought of the meetings, viz., how to secure better teaching.

Reported by

LYMAN C. NEWELL.
STATE NORMAL SCHOOL, LOWELL, MASS.

EARTH SCIENCE SECTION.

The Earth Science Section met on Friday afternoon, December 27, and on the morning of Saturday, December 28.

At the first session the subject for discussion was the question of 'Geography for Training Students in the Normal Schools.' Discussion was opened by four twenty-minute papers given by Professor A. W. Farnham, of the Oswego State Normal School; Professor C. Stuart Gager, of the New York Normal College, Albany; Principal C. T. McFarland, of the Brockport Normal School; and Professor W. S. Monroe, of the State Normal School, Westfield, Mass. The first two speakers paid particular attention to the work in physical geography that should be presented to normal students who are intending to teach in the elementary schools; the last two speakers emphasized particularly the human side of the work as it should be presented, Professor Monroe outlining at some length what to his mind should be included in such a course in reference to the races of men and their conditions and characteristics as related to their environment. All speakers agreed on the necessity of more time for geography work in the normal schools of New York State, and particularly for better coordination of the work, so as to secure more efficient geographical training.

The second session was devoted to the discussion of the preliminary report presented by the Committee of Seven appointed in 1900 to outline a course in physical geography for the secondary schools of New York State. Mimeographed copies of the report of the committee and of the course suggested by the committee were in the hands of all who attended. After a brief presentation of the main points of view held by the committee the discussion was led by Head Inspector C. F. Wheelock, of the Regent's Office; Professor A. P. Brigham, of Colgate University; and Miss Elizabeth E. Meserve, of the Free Academy, Utica. Informal discussion under a five-minute rule followed, and was participated in by many of those present.

Both sessions were particularly helpful and suggestive, and great interest was shown in the problems presented for discussion. At the close of the meeting it was voted to ask the Association to continue the Committee of Seven for one year, with the expectation that it would, at the end of that time, present a series of laboratory exercises for Physical Geography in Secondary Schools, and a Course of Study for Elementary Schools.

Richard E. Dodge,
Chairman.
Teachers College,
Columbia University.

NATURE STUDY SECTION.

The program for this section was designed to bring out the opinions of those present on the training that a teacher should have in order to teach nature study. The first session was devoted to papers and discussions on these matters, and the second session to the relating of personal experience by teachers actually engaged in carrying on nature study work successfully in their schools.

The speakers were all present and the discussions were taken up with much vigor and interest. We agreed that the basis for successfully teaching nature study lies in an interest in the subject, a belief in its educational value in the broadest sense, and in a certain amount of personal experience with nature itself. That more training is desirable, if added to the above essentials, was admitted by all.

Miss Hill, Miss Carss and Professor Bardwell showed how much could be done by trained nature students in the instructing of both children and teachers. But it was shown by Miss King, Miss Whittaker, Miss Mershon, Mr. Round and Mr. Drum that special science training is not absolutely necessary to carry out the spirit of true nature study.

Mr. Beach, in presenting his plan for teachers' classes made practical suggestions which recommended themselves to all. No doubt many such classes will be formed during the coming year in cities. Mention was made of the correspondence course for teachers, conducted by the Bureau of Nature Study at Cornell University. Teachers were urged to make use of every available opportunity to increase their knowledge of subject matter, not in order that they may teach facts, but in order that they may teach their pupils how to learn from nature.

Mary Rogers Miller,
Chairman.
Cornell University.

SECTION OF BIOLOGY.

Four papers were read and discussed:

The Preparation of Secondary Teachers in Biology: Professor F. E. Lloyd, Teachers College, Columbia University.

The high school is the 'college of the people' in a wide sense and worthy of the best efforts of well-educated and trained teachers. Owing to the inadequate preparation of many teachers the present work in biology shows a lack of uniformity in ideals, unevenness in the quality of instruction, and a remarkably heterogeneous high school course, taking the country as a whole. Those preparing for the profession of secondary teaching in biology should hold the bachelor's degree, and should have studied physics and chemistry. In biology they should have earned at least nine points credit before graduation, one third of which should have been in botany or zoology. Following this course of study they should have a professional training, including psychology, history and principles of education, special study of the problems of the high school and a course in the theory and practice of teaching biology in secondary schools. This latter course embraces two parts: (*a*) Theory, consisting of lectures and reading on the history and aims of the teaching of biology, on courses of study, topics, etc.; (*b*) practice, consisting in observation of teaching, construction of a course of study and examination of available materials. This course culminates in a season of actual teaching under skilled criticism. During the course the candidate should pursue advanced work in botany and zoology.

Such a course may well be made to lead up to the conferring of degrees coordinate with those of law and medical schools and equal to them in significance.

What the Teacher of Botany in Secondary Schools should be Prepared to do: Dr. A. J. GROUT, Boys' High School, Brooklyn.

Ideals in Teaching: Professor A. D. MORRILL, Hamilton College, Clinton, N. Y.

In the modern teaching of natural history one of the first ideals to hold sway was taxonomy, then, the study of types, and, later, the investigation of physiological processes. At present no single ideal is in vogue. Along with these more or less clearly conceived general ideals there have grown up minor ideals which often are of an extra-scientific nature. Trimming the principles of biology to meet the exigencies of a set examination is a spectacle often seen in our midst.

In elementary work the pupil is of much greater importance than the subject, but many teachers think more of the symmetrical presentation of their subject than of creating in the minds of their pupils a liking for science. A similar blindness to proper methods leads other teachers to dull all the interest of discovery by giving preliminary lectures and demonstrations which make the laboratory period one of uninteresting verification.

The ideal best calculated to help the young pupil to break away from the dominating authority of books is the one that leads him into the paths of nature so that he comes upon the truths himself.

Well-directed work in biology develops individuality and independence in judgment. The example of one earnest, interested and independent student in a class is not less successful than that of the instructor in bringing indifferent workers into line.

The Training of a Science Teacher for Secondary Schools: Professor N. A. HARVEY, Chicago Normal School.

A teacher of science in a high school ought to know: (1) His subject, (2) the psychological movements involved in learning the subject, (3) the principles and the art of teaching.

Without knowledge of the subject matter, as complete as possible, no substantial progress can be made. But the teacher must not pursue one line of research to such a degree as to become one-sided, lest he attempt to drill his pupils in the methods of the trained investigator.

If the teacher would avoid the use of men's methods in trying to develop children's minds he must have more than a theoretical knowledge of the general laws of mental action. He must bring the mind of the child into the presence of truth in such a way that its activity will be aroused and growth will result.

Under the prevailing limitations, the normal schools do not properly train teachers for the high schools. Neither do colleges and universities offer an ideal preparation for the science teacher. The latter are occupied too exclusively with the idea of storing up knowledge, with little or no consideration of the psychology of the process.

There are three alternatives for securing better trained teachers: (1) Normal schools may modify their courses to meet the demands for high school teachers; (2) universities may change courses in pedagogy by introducing practice in teaching; (3) the science teacher may get the knowledge of his specialty in the university and his pedagogical training in the normal school.

HENRY R. LINVILLE,
Chairman.

DEWITT CLINTON HIGH SCHOOL, NEW YORK.

*THE FUTURE OF VEGETABLE PATHOLOGY.**

ON this occasion, as president of the Ohio Academy, it is incumbent upon me to deliver an address, presumably upon some phase of the body of knowledge we call science. Custom points no less unerringly to some topic along the lines of one's chosen pursuit. Doubtless, without any announcement a botanical heading would be assigned to this occasion. For various reasons it has seemed fitting to present to you some thoughts on 'The Future of Vegetable Pathology.' Certainly this cannot be done without considering the history of the rise and progress, nor without discussing the present status of plant pathology from the standpoint both of the investigator and of the teacher. These matters are likely to lead to estimates concerning the rank of vegetable pathology among the divisions of botanical science. Concerning the speaker personally, it is known to most of you that his pursuits are along the line of the study and investigation of plant disease.

Since it is in the cultural aspects of plant life rather than in the original condition of wild plants that pathology has claimed the largest attention, we naturally look to that phase for much of its history. The advance of our knowledge in this helpful line has certainly been gratifying during the closing decade of the nineteenth century.

Plants, as dynamic factors, exhibit certain general and normal activities discernible under widely different conditions of environment, and recognizable in plants of external dissimilarity; the study of these normal activities leads us to plant physiology. At the same time these plants in their usual activities are impinged upon by certain special and general phases of environment, by varying climatic conditions embracing differences in the amounts of heat, light and humidity, exposure to dryness in air or soil, as well as the encroachments of animal life by the cropping of herbivors or the fretting of insects. In response to continuously acting stimuli of this character the plants become modified or adapted to the conditions surrounding them; the study of this adaption leads to ecology.

Studying still these same plants as living organisms, and either in their general functional activities or in their external and internal adaptations or in both, we find that the course of life of the plant is by no means always normal—instead of simple turgor we may have intumescence or edema (dropsy, as our physicians would say); instead of the free water flow contemplated through the conducting tissues we may find the vessels closed. Not only this, external and internal parasites may attack any and all organs of the plants, intercepting light and heat, absorbing, destroying or diverting the usual nutritive substance, penetrating and transforming essential organic tissues, and even totally preventing the attainment of the reproductive functions; these parasites may lie in wait in the soil, be wafted in the winds or be sown with the seed of the husbandman. Otherwise incapable of striking expression by external signs, the plant may find itself fixed in a soil with inadequate or unsuitable or even injurious substances contained therein; accordingly there is stunted growth, reduced vigor or manifest ill health indicated by fruit or foliage. Abnormalities are seen in such and in other ways; their study just as certainly leads us to vegetable pathology.

Pathology is then at least tentatively ranked coordinately with physiology and ecology among the divisions of botanical science which have to do with plants in their life relations. No one of these divisions just enumerated, more than an-

* Presidential address before the Ohio Academy of Science, November 29, 1901.

other, may be successfully cultivated without some knowledge of the other divisions of botany and of allied sciences.

Historically, vegetable pathology has been studied for a long time; at least one work on 'Maladies des Plantes' has a title page date of the early fifties. Of two German works in the nature of general treatises on this subject, still useful, the first editions were issued in the years 1874 and 1880, respectively: I refer to the handbooks of Sorauer and Frank, both of which have passed through subsequent editions. The lamented Winter's little work, 'Die durch Pilze verursachten Krankheiten der Kultur Gewachse,' belongs to about the same period (1878). These were followed by almost synchronous publication of works by Prilleux, Hallier, Tubeuf, Berlese and Marchal in French, German and Italian, respectively. Tubeuf's book was soon translated into English by Smith, and its appearance in that dress has been followed by the handbook of Massée, and by the recent and most excellent work by H. Marshall Ward under the title 'Disease in Plants.'

There are journals too, including the *Zeitschrift für Pflanzen-krankheiten,* edited by Sorauer, now in its eleventh volume, the Zweite Abtheilung of the *Centralblatt für Bakteriologie und Parasitenkunde,* now in its sixth volume. The Italians have the *Rivista di Patologia Vegetale,* of many years' standing, edited by Berlese, and the Dutch the *Tidschrift over Planten Ziekten* edited by Ritzema-Bos. In England society proceedings and journals have been the chief avenues of publication for work on plant diseases; while in the United States, aside from the *Journal of Mycology* instituted by Dr. Kellerman while in Kansas, now no longer published, the publications of the United States Department of Agriculture and of the various experiment stations in the several states have been the chief agencies by which a large and valuable literature on plant diseases has been issued.

Looking at the subject in this manner, we are led to conclude that plant pathology has possessed a well-arranged and systematic body of facts bearing upon the subject, during a period of at least twenty years, and that this body of knowledge has been accessible for that length of time in the form of published handbooks; and further that it has possessed, and still possesses, a large literature issued in periodical form and covering the multitudinous phases of the subject in question.

Has plant pathology meanwhile assumed the coordinate rank herein indicated along with plant physiology and ecology? I fear we must answer negatively in so far as college professorships and university courses are concerned. Aside from the few universities which offer rather brief undergraduate courses in 'vegetable pathology' or in 'plant diseases,' most, or I might say all, American university and college courses offered by well developed botanical departments, consisting of two or more chairs in botany, are silent on this subject.

If the elements of the subject are taught at all they are presented under either plant physiology or the systematic study of fungi, and it is notable that in America's oldest and largest university this division of botany is not recognized as existing. Professor Ward, to whom reference has already been made, responds in a recent letter that his work in plant diseases is all research work and that he offers no separate course upon the subject.

It is easy to understand that up to a recent time no well formulated call had been made for students equipped in this line, and that therefore no demand existed for courses in plant pathology, but certainly the recent expansion in experiment station work, and in that of the United States Department of Agriculture, no longer leaves this position tenable. The writer has sometimes wondered whether we have in this tardiness to apply botany in vegetable pathology a sort of unwillingness or reluctance to place applied science upon a coordinate basis with pure science. Many are aware how relentless was the opposition of the representatives of the old education to putting engineering or applied science courses upon the same basis as the arts course for graduation. Indeed, if I am not mistaken, certain institutions still discriminate against graduates in engineering. Seeing that all this is history, and noting that applied science in the domain of living things offers great difficulties by reason of the variations in the organisms themselves than the sciences applied in engineering and other technological lines, it ought not to surprise us that this applied botany should make at times slow advances. Such has been the case all along the line of agricultural application. It would not be against some things that have already passed into history were the lingering, or inherent hostility to useful knowledge as a part of the subject matter of collegiate instruction to have had something to do with the tardy recognition given to plant pathology in this, the foremost country of the earth, in the application of the remedial methods its study has brought to our people. A good many of us have heard the sneer often accorded to really fine work in applied botany.

However much weight we may give the foregoing considerations, it must not be denied that vegetable pathology as a well-rounded division of botany has been compelled to pass severe tests, to suffer disadvantages.

The tendency in some quarters to restrict the application of the term vegetable pathology to a study of the cryptogamic parasites upon plants has been a great drawback. Parasitology has been developed to the narrowing and dwarfing of the true science. Doubtless this is the idea which finds expression in the catalogued courses of 'economic mycology.' One well-known and liberal-minded botanist, himself a professor of botany, made the remark to me some two years ago that he would acknowledge that we possessed a science of plant parasitology, but that the science of plant pathology seemed to him to require building up on the non-parasitic side before we could consider it a well-developed division of the science of botany. I may mention here in passing that the development in this country of economic entomology, apart from botany, wherein its application rests if it attain economic rank as to plants, has also divided forces when compared with the course of events in Germany and the remainder of Continental Europe.

Granting that the immediate demands for it and the recognized value of the results of the study of fungus parasites have developed the science unequally or disproportionately in that direction, recent advances have certainly tended in a large measure to correct this tendency. While we do not yet know the exact interrelations out of which harm results from the unlocking of oxidizing enzyms at unpropitious times, as is now believed to be true in yellows of the peach and in the mosaic disease of herbaceous plants, notably of tobacco, progress towards a knowledge of this abnormal 'stoffwechsel' has certainly been rapid and has apparently proceeded along safe lines. That many normal processes in plants remain obscure or unsolved does not discourage the plant physiologist; no more should the obscurity of the abnormal deviations cause the plant pathologist to desist from his triumphant progress.

A prominent plant physiologist has recently asserted that an adequate explanation of so simple and fundamental a process as the ascent of sap in plants yet remains to be proposed; other problems in physiology are stated to be equally unsolved. In a like position the vegetable pathologist finds himself with respect to some of the problems of pathology. Unsolved problems there are, and unsolved problems there will remain so long as men continue yearly to extend the boundaries of our knowledge of plant life.

I feel well assured that the state of our knowledge warrants us in recognizing plant pathology as a well-established division of botanical science entitled to the coordinate rank I have earlier indicated. If this be granted then what reasonable grounds exist to warrant the arrangement of courses and the establishment of chairs of vegetable pathology? I think the basis of our modern education affords us but one answer. The state charges itself with educational matters in order that her citizens may be more useful in perpetuating the state and in contributing to its welfare and prosperity. The state is already demanding the services of those who are capable of assisting agriculture by controlling the diseases of culture plants; with the lapse of years these demands promise to develop in increasing proportions.

The institutions of learning which leave their graduates without all the training for this work that the state of our knowledge affords are missing one of the fairest opportunities for usefulness. The graduate who finds that his notes on economic mycology fail to connect his parasite adequately with the changes in its host, will probably accuse his instructor of leaving him to find out for himself what he should have been taught in some manner, at least, while he had a student's leisure and before the unceasing demands of actual service pressed upon him. Generally speaking, American institutions leave the student in this position, or offer him an excellent opportunity to make his own pathological inferences from physiological instruction. In my judgment, the demand for well-considered instruction and research in plant pathology is already formulated and only awaits avenues of expression to make itself felt. It would seem that the land grant colleges and state universities are situated at a great advantage by their opportunities, in the line of courses in a pathological botany that shall be pedagogically sound and actually immediately helpful. They have this fine opportunity because of their relations to the state at large and to the agricultural community in particular, and by either direct or contributory connection with the experiment stations and the United States Department of Agriculture. Have such courses been made prominent and are these great institutions realizing their full opportunities? And are the time and facilities in the way of helpers allotted in our state university or elsewhere, such as make nothing more to be desired? To both of these questions most would give either a qualified or an unqualified negative answer. So long as this is true much remains to be done for the future of vegetable pathology. It may be added that so far as my own inquiries and those of certain of my friends have extended, we find plenty of disposition to create separate chairs in botany in our universities, and properly so, but there is little manifest disposition to provide for instruction in plant pathology. If we contrast this apparent indisposition—I say *apparent* advisedly, for those on the outside can judge as to what is being considered within only by announcements—if, I repeat, we contrast this apparent indisposition of the institutions training the future physicians of the plant world with that existing in medical colleges wherein there is a very concrete division of pathological subjects, we are forced to conclude that a great deal remains to be done to provide adequately for the future instruction that I am well assured is to be given in vegetable pathology.

A body of well-organized knowledge on plant diseases presented by teachers charged chiefly or solely with the giving of courses or the conduct of investigations in plant pathology is, I am led to believe, not solely by the course of demand for workers, but as well by the development of our agriculture practice, to be the future of vegetable pathology. In so far as I am aware, the only university whose officials have, as yet, expressed a desire and future purpose to put plant pathology on this foundation for the future is not, as one would expect, endowed by public funds, but by private philanthropy. I am hopeful that this will not long remain the case.

In choosing this subject and in the manner of presenting it, I have been guided, as herein set forth inadequately, by a desire to make plain the disproportion between the demands, in the line of applied botany, made upon many of the most competent graduates in botany and in the preparation they have been given for this work. It is recognized that at no other period of the world's history have the universities of the time been subjected to such stress and expense in equipping for the demands of instruction as have fallen upon those of our own day within the last two decades, more especially within the last one. Under these circumstances, with the achievements of applied physical and chemical science in the minds and on the lips of the inhabitants of both town and country, it is not surprising that the equally important economic achievements in botanical science, and especially in pathology, should have been passed without much consideration by a great number whose interests and training lead them to look elsewhere. What has been stated has been offered in the spirit of friendly suggestion and with no desire to misstate or misapply the facts as they now exist. Should this appear to have been done, it will be my greatest pleasure to make corrections.

It is quite generally recognized at the present day that some of the brilliant hopes of the chemist respecting improvement in plant growth have failed of realization, and that after all the sciences which deal with living things have their problems worthy the most competent and best equipped of our scientists. The chemist will now admit that mere chemical analysis of the plant substances gives no adequate knowledge whereby we may solve the vexing problems of plant nutrition, valuable and helpful as the analysis has been. We as botanists, are justified in the faith that our beloved science is at last to come into possession of her full heritage of problems as well as opportunities. Certainly the unrivaled development of American botany in recent years justifies a faith of this sort.

I have thus with hasty preparation, and, as I am well aware, very imperfectly as to result, taken this much of your valuable time in discussing what appears clearly to me to be the larger possibilities of the future of vegetable pathology.

AUGUSTINE D. SELBY.
OHIO AGRICULTURAL EXPERIMENT STATION,
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SCIENTIFIC BOOKS.

Briefwechsel zwischen J. Berzelius und F. Wöhler im Auftrage der königl. Gesellschaft der Wissenschaften zu Göttingen. Mit einem Commentar von J. VON BRAUN; herausgegeben von O. WALLACH. Leipzig, Verlag von Wilhelm Engelmann. 1901. Two vols., 8vo. Vol. I., pp. xxii + 717, with portrait of Berzelius; Vol. II., pp. 774, with portrait of Wöhler.

Thanks to the great care with which the

persons addressed preserved the letters received, and to the circumstance that this was the habit of both parties, chemists can now examine the voluminous correspondence maintained by the Swedish master Berzelius and his famous pupil Wöhler, throughout a long period of years (1823–1848). After the death of Berzelius, Wöhler presented the letters received from him to the Royal Academy of Sciences of Sweden with the condition that they should be kept secret until January 1, 1900; and Berzelius' widow sent the letters written to him by Wöhler to the same institution, whence they were afterwards transferred to the University library of Göttingen. The two large volumes reproducing these letters are published under the auspices of the Royal Academy of Sciences of the same town.

The correspondence begins with a letter written by Wöhler from Heidelberg, July 17, 1823, stating that the eminent professor of chemistry at Heidelberg, Leopold Gmelin, had suggested his applying to Berzelius for permission to continue his chemical studies in the laboratory of the distinguished Swede. At that date Wöhler had published four researches that may have been known to Berzelius, the first in 1821, when Wöhler was twenty-one years of age, narrating his discovery of selenium in a Bohemian mineral and in the oil of vitriol manufactured therefrom. Berzelius replied favorably and a few months later Wöhler made the journey to Stockholm, where he passed the winter of 1823–24. The last letter in the work was written by Svanberg to Wöhler on August 8, 1848, and announced the death of Berzelius; the intervening letters depict the intimate relations that existed between the two chemists.

The high opinion formed by Berzelius for his young pupil was fully justified when, within four years of his studentship, Wöhler was able to write to his former master of his brilliant discoveries of aluminium and of urea; the first in a letter dated October 10, 1827, and the second in a letter of February, 1828. To these announcements Berzelius answered with enthusiasm, 'Aluminium and artificial urea, truly very different bodies, following so close to each other, will be the precious gems in the laurel wreath woven for thy brow.'

Besides their personal successes in chemistry the friends wrote to each other of the labors of their contemporaries and friends; the Swede wrote to the German of the discoveries being made by Mosander, who had been nicknamed 'Father Moses,' of the claims of Gay Lussac, of his opinion of Gerhardt, and of various domestic and family matters.

On the other hand, Wöhler had many things of interest to communicate; he wrote of his joint investigations begun with Liebig in 1830, and in the same year of his marriage. In 1832 the letters are full of incidents; Liebig discovers chloroform and chloral, Faraday discovers voltaic induction, Wöhler's wife died (in 1834 he married a second time), Liebig received a visit from Wöhler in Giessen and they began to investigate bitter almond oil.

Events then marched rapidly; in 1835 Berzelius visited Paris, and Wöhler journeyed to London, after which the two met in Bonn and traveled together to Cassel. This meeting was a source of great pleasure to both the friends, who now pledged themselves in brotherhood (*bruderschaft*); they met but once again in life, at Göttingen in 1845.

In 1836 Wöhler received a call to Göttingen, Berzelius married and was made a baron; in 1837 Bunsen investigated cacodyl, and the unfortunate quarrel between Berzelius and Liebig began with an attack by the latter.

Among the innumerable items of value in these 1,500 pages, one may be cited of special interest to American chemists. In June, 1833, Wöhler wrote to Berzelius that a young American, a pupil of Silliman, had been studying with him for some months, and in December of the same year he again mentions him, this time by his name, Booth, and says he wishes to continue his studies under Berzelius if he (Booth) can obtain permission. In this connection Wöhler writes handsomely of the American's ability, industry and absolute trustworthiness. Those who remember the late Professor James Curtis Booth, for forty years melter and refiner in the United States Mint of Philadelphia, and in 1883, 1884 and

1885 President of the American Chemical Society, will be pleased to note the accurate forecast of his character made by Wöhler fifty years before. Booth, however, did not go to Sweden, as Berzelius replied he was too old to take charge of any students.

The reviewer can give but a birdseye survey of the extraordinary value of these volumes as contributions to the history of chemistry. An index of proper names adds to their usefulness.

Henry Carrington Bolton.

Reports of the Cambridge Anthropological Expedition to Torres Straits, Volume II. *Physiology and Psychology.* Part I. 'Introduction and Vision.' Cambridge, The University Press. 1901. 4to. Pp. 140.

The inclusion of psychological tests in the anthropological survey of the status of primitive peoples is a noteworthy tendency of recent investigation, and one worthy of the highest commendation. No more interesting contribution of this nature has been made than the one just published by the Cambridge expedition, the general director of which is Mr. A. C. Haddon. The psychological observations are due to W. H. R. Rivers. While many of the observations are rather undeveloped in type and made under unfavorable conditions, yet the whole research embodies a considerable amount of material that is suggestive even where it fails to be conclusive. Mr. Rivers is entitled to great credit for the inauguration and the successful completion of this series of tests.

The direction of such an enterprise involves great tact, a constant watchfulness for sources of error, encounter with difficulties of language and the explanation of what was wanted. The men had to be given tobacco and the children sweets as rewards of merit for having their eyesight tested, while at the same time an appeal to their vanity was very efficacious. The story was circulated that the black man could see and hear better than the white man, and that the white man had come to see whether this was so and would record the results in a big book for all to read. An overzealous native, in impressing the necessity of truthfulness in answering the questions asked, had hinted that Queen Victoria would send a man-of-war to punish those who told lies, and so frightened off a group of subjects altogether. But on the whole, Mr. Rivers presents satisfactory evidences that the natives understood what was desired and were able to give proper attention to the test.

Only a few of the more significant results can here be presented in outline. Visual acuity was tested in several ways, the best being by the use of the letter E in various positions (Snellen's Haken). This character was presented in various sizes and arrangements and the subject required to hold a sample character, which he had in his hand, in the position of a given character exhibited at a standard distance. The smallest size of the character distinguishable at the standard distance would thus be a measure of the visual efficiency according to the usual procedure. In one group of natives there were two thirds who had vision between two and three times what is commonly supposed to be normal European vision. This conclusion must be somewhat modified in view of the difficulty of obtaining precisely comparable European standards and in limiting the subjects to those presenting no decided refractive defects. Yet the balance of evidence is in favor of a slight superiority of the vision among 'Naturvölker' as compared with 'Culturvölker.' Bringing this into relation with the widely circulated reports of the marvelous visual powers of savages, Mr. Rivers decidedly agrees with those who interpret such proficiency as, in the main, a psychological one. It is because the savage in his limited world knows what to look for, that he is able to recognize objects at a greater distance; and when the European attains an equal familiarity with the environment he is likewise able to observe what previously passed his closest scrutiny. Mr. Rivers cites a case in point from Ranke who was astonished that the Indians (of South America) 'could tell the sex of a deer at a distance which would have implied vision at an extremely small angle if the distinction had depended on seeing the antlers,' but who found that he could make the like distinction when once he had noticed the characteristic difference of the gait in the two sexes. Likewise Mr. Rivers' Papuans, though they possessed a superior vision, yet detected the presence of a steamer in a neighboring harbor mainly by knowing what to look for at so great a distance. A few supplementary results may add interest to this general conclusion. It appears that the women had as good vision as the men, that decline of vision seemed to set in at an earlier age among the Torres Strait natives (æt. 35) than among Europeans (æt. 50), and that they, furthermore, did not exhibit the rapid improvement with a given test which is a common observation among Europeans. Myopia was distinctly less common than among Europeans, and this alone would account for an average superiority of visual acuteness. It appeared, too, that the natives could see more clearly with feeble illumination and were able to distinguish the faint gray rings produced by slight black patches on a rotating white disc (Masson's discs) better than Europeans.

Mr. Rivers' examinations of the color sense were quite extensive and included some very interesting notes on the color vocabulary in the several native languages. The relative absence of the typical form of color blindness (confusion of reds with greens) among the people examined corroborates the result found by others, that color blindness of this type is distinctly more prevalent among European peoples. Mr. Rivers gives strong reasons for concluding that his subjects exhibited a certain degree of insensitiveness to blue (and possibly green) as compared with Europeans. The result, in a measure, strengthens Gladstone's contention of the relatively late introduction of blue in the color evolution of the race, but it gives that conclusion a different and far more rational setting. A third group of visual experiments related to the space perceptions and the sensitiveness to certain common illusions of length and direction comparisons. Here a brief résumé is hardly possible, but suggestions of interest are the following: the well-known Mueller-Lyer illusion (of the apparent greater length of a line having divergent pairs of oblique lines at its extremities, like the feathering of an arrow, above an equal line with convergent oblique terminations) is distinctly less marked to the Torres Strait natives than to Europeans; the former are relatively less variable among themselves in judgments of this type than a comparable group of Europeans; several other illusions involving interpretative factors were less marked than they would be to Europeans, while a few that depended upon the physiological shortcomings of the eye seemed on the whole more obvious than to uninstructed Europeans.

Many of these suggestions offer tangible points of corroboration or the opposite, of general notions as to the effect of civilization upon the sensory endowment of man. Mr. Rivers throws out the pertinent thought that a superiority of minute sensory observation may well be the characteristic of the more primitive mind, and that this form of excellence may be prejudicial to the more general use of the senses as the servants of the judgment and associative interpretation upon which education depends. He suggests that the less marked sensitiveness of his subjects to certain illusions may be an evidence of this, since they see only the parts and not the whole; and it is the conception of the geometric figures as a whole that brings in the contrast upon which the illusion depends. "If too much energy is expended on the sensory foundations, it is natural that the intellectual superstructure should suffer. It seems possible that the over-development of the sensory side of the mental life may help to account for another characteristic of the savage mind. There is, I think, little doubt that the uncivilized man does not take the same æsthetic interest in nature that is found among civilized peoples." And this, according to Ranke, is due to the savage absorption in the useful details of nature and his consequent inability to see the larger relations. "Ranke's experience is strongly in favor of the view that the predominant attention of the savage to concrete things around him may act as an obstacle to higher mental development."

We are as yet far from an adequate view of the essential transformation of the psychological equipment that has been concomitant with the transition from primitive to civilized conditions. It is equally certain that many of the current notions as to the likenesses and differences of 'Naturvölker' and 'Culturvölker' rest upon presuppositions rather than upon proper observation. Such researches as this of Mr. Rivers bear the possibility of clarifying our views as to these interesting relations. JOSEPH JASTROW.

MADISON, WISCONSIN.

Monograph of the Coccidæ of the British Isles. By ROBERT NEWSTEAD. London, Ray Society, 1901.* Vol. I. Pp. 220, Pls. A–E, and I.–XXXIV.

This is the first comprehensive work on the British Coccidæ and is the result of over ten years' study by the author, who is the foremost authority on scale insects in England. The term 'British' is permitted to have a very elastic meaning, since all species found living in Britain are included—even those on hothouse plants and on fruits in the market. Thus, the *Diaspis* of cacti is duly given a place, though nobody would think of treating the cacti themselves as members of the British flora. Indeed, of the thirty-eight species discussed in the volume, only six are genuine natives of the country. This peculiar interpretation of the term 'British' is wholly justifiable when we consider the fact that many of the most injurious coccids are those which have been introduced, and indeed those most commonly met with are found in hothouses on imported plants. If Mr. Newstead had confined his researches to the indigenous species, his volume would have been of comparatively small practical value to the British coccidologist or horticulturist; and as the mode of occurrence of each is precisely stated there need be no confusion. Of the thirty-eight species, no less than thirty-one have also been taken in America, so it will readily be seen that the work is of much importance to us in this country. Every species is carefully described, and there are beautiful colored plates of most, as well as line drawings illustrating the minute structural characters. Biological facts of the greatest interest are recorded. The genus *Aulacaspis,* of the present writer, is accepted, but defined by entirely new characters. It results from this that it includes a quite different series of species from those hitherto referred to it, except, of course, that the type species (*A. rosæ*) remains as before. I find, upon renewed study, that this new interpretation is apparently correct, and it marks a considerable advance in classification. *Aulacaspis* is now seen to be an Old World genus, while *Diaspis* is mainly American.

The common mussel-scale of the orange is referred to *Mytilaspis pinnæformis,* but I think incorrectly. The insect of this name occurs on orchids, while that of the orange (*M. beckii*) has never been seen by me on these plants, though it might be common on orange trees with plenty of orchids growing near, as is the case in Jamaica. We have to do, perhaps, with a case of 'physiological species,' and there is an opportunity for some one to try experiments in transferring the coccids from one plant to another.

Altogether, the work is a very admirable one. The only serious fault I find is that the author has not taken sufficient pains to examine the literature of his subject. Thus, he often quotes Cooley's paper on *Chionaspis,* and yet failed to learn from it that the so-called *C. salicis* of this country is not identical with the European species. The statements about the exotic distribution of the species are frequently incomplete, and sometimes inaccurate. In several cases, names are cited in the synonymy which were never printed in the places cited; thus Leonardi wrote *Aspidiotus* (*Selenaspis*) *articulatus,* but Newstead cites it *Selenaspis articulatus,* treating the subgenus as a genus in the synonymy, though he himself regards it as only a subgenus.

T. D. A. COCKERELL.

EAST LAS VEGAS, N. M.

* It may be useful to state that the actual date of publication was the middle of December, 1901.

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES.

SECTION OF GEOLOGY AND MINERALOGY.

THE regular meeting of the Section was held Monday evening, March 17, with Dr. A.

A. Julien, chairman, presiding. This being the annual meeting of the Section, the first business of the evening was the election of officers for the ensuing year. Professor R. E. Dodge nominated Professor J. J. Stevenson for chairman and Dr. E. O. Hovey for secretary. On motion of George F. Kunz, W. H. J. Sieberg was directed by unanimous vote of the Section to cast one affirmative ballot for the nominees. He did so and they were declared elected.

The following program was then offered:

George F. Kunz made an exhibition of specimens illustrating the finding of epidote, grossularite, garnet and twinned crystals of quartz of the Japanese type, associated with chalcopyrite, malachite and other ores of copper in a contact vein in limestone in the Green Monster Mining Co.'s mine near Solzer, Prince of Wales' Island, Alaska.

'The Centenary of John Playfair's Defense of James Hutton's Theory of the Formation River Valley': Memorials by Professors J. J. Stevenson, J. F. Kemp and R. E. Dodge.

Professor Stevenson, after speaking of the conditions prevailing in British geology prior to the publication of Hutton's memoir in 1785, gave briefly the characteristic features of Hutton's doctrines, and accounted for the ease with which his work could be misunderstood and misinterpreted. He described the conflict to which the memoir led, and emphasized the bitterness of those who opposed the doctrine on theological grounds. The preparation of Playfair's work was due as much to a desire to defend Hutton as to support his theory. Playfair appealed to those opponents whose knowledge of the theory had been derived chiefly from attacks made upon it. For them he showed that the theory was beautiful, symmetrical and in no sense inconsistent with the Scriptures. In dealing with the other class of opponent, led by Kirwan and DeLuc, he used vigorous language exposing their ignorance and insincerity, and denouncing the virulence with which they had given a theological turn to the controversy. In defending Hutton's theory, Playfair brought his own great resources to bear, now correcting errors, now elaborating the doctrine, and in some places hardly anticipating some of the great works of later days.

The inviting style gained many readers for Playfair's book, among them Greenough and his associates, who founded the Geological Society of London, that theory might be replaced by observation. Hutton's theory obtained final triumph in 1830, when Lyell published his 'Principles.' Playfair's work hastened the birth of geology as now understood by a full quarter of a century, and finally divorced our science from cosmogony.

Professor Kemp's memorial was more in the nature of a review of Hutton's personal history. He said in part: James Hutton was born in 1826, and, after his school and university course, entered a lawyer's office to prepare for the bar. He disliked the law, however, and gave up the study after a year. Being greatly interested in chemistry, he took up the study of medicine, attending lectures at Edinburgh and Paris and taking his degree at Leyden in 1749. The career of a physician did not attract him much, after all his preparation, and in 1752 he went to Norfolk to learn agriculture. There his mind first turned definitely to mineralogy and geology. In 1754 he settled on his ancestral estates in Berwickshire, where he remained fourteen years, with occasional visits to Edinburgh and more distant parts of the kingdom. In 1768 he gave up country life and removed to Edinburgh to devote himself entirely to the study of geology and kindred sciences. His untiring industry enabled him to accomplish a marvelous amount of work in chemistry and finally to elaborate his essays in geology, revolutionizing that science and, with the elucidation given his work by Playfair's 'Illustrations of the Huttonian Theory of the Earth,' raising it to the high plane which it has occupied ever since. Modern geology dates from the publication in the spring of 1802 of John Playfair's explanation, elaboration and defense of Hutton's theories.

Professor Dodge, in his memorial of Playfair, said in brief:

To James Hutton we owe many fundamental truths now recognized in physiography, and to John Playfair we owe the elucidation of these ideas, and their amplification.

The doctrine that rivers are the cause of their valleys, and the proof thereof is perhaps the most important foundational idea that we owe to the combined labor of these two geological worthies. Playfair's clear exposition of the possible origin of river terraces, his acute description of the relation of lakes to rivers, his analysis of the varied forms of shore lines, and his emphasis of the importance of initial shore lines, all clearly exploited in his illustrations, deserve to take rank with the much-quoted passage on rivers and their valleys, as being accepted geographical truths far in advance of their time.

After the reading of these memorials the Section listened to two papers by Professor R. E. Dodge and one by Gilbert van Ingen, all of which were illustrated by means of the lantern.

Professor Dodge's first paper was entitled 'An Interesting Landslide in the Chaco Cañon, New Mexico,' and he said in brief:

On a high mesa to the southeast of the Chaco Cañon, and about four miles below Putnam, New Mexico, is a series of stone monuments about five feet high and four feet in diameter. These monuments stand on the edge of rim rocks of an old escarpment three hundred feet high. The rim rock of the escarpment is a coarse brown sandstone capped by about two feet of thin-bedded dark brown sandstone containing sharks' teeth. The face of the escarpment has recently slipped along a series of joints running approximately parallel to face of escarpment, and in a general direction of S. 30° E. The recesses between slipped blocks can be sounded to a depth of over fifty feet, and are wider at base than at top as a rule.

In the slipping an ancient rock hogan twenty feet in diameter has slid 2.5 feet vertically and 8.3 feet horizontally without displacing the rock walls to any serious extent.

The second paper by the same author was on 'Arroyo Formation.' An arroyo is a steep-sided, narrow gulch cut in a previously filled gravel and adobe valley in the arid West.

The study of the process of formation of arroyos, some of which have been under observation for several years, seems to show that the work has changed from aggradation to degradation because of some influence that has caused the focusing of the running water. Such a concentration of water is made possible by over-grazing of the land, which removes the help of roots in holding soil particles, combined with the habit of cattle to move in processions along trails that make a natural channel for water.

The study of the rate of valley-filling or erosion is difficult, because of the tendency of arroyos cut in adobe to maintain nearly vertical walls, and because a fallen block of adobe may be sealed over in the next flood, so that it looks in place. This problem is of especial importance, because the adobe deposits in some places contain relics of human occupation to a depth of many feet. The exact or even the approximate antiquity of the deposits cannot be definitely determined, because of the several ways in which the order of events in such a case may be interpreted.

Mr. van Ingen's paper was on 'The Ausable Chasm,' and gave a description of the geology and physical features of this celebrated locality which incorporated the results of the author's own observations with those which had been arrived at and published by others.

Edmund O. Hovey,
Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON.

The 354th meeting was held on Saturday evening, April 19.

Barton W. Evermann and E. L. Goldsborough presented 'Notes on Some Mexican Fishes,' based upon collections made in Mexico and Central America by Mr. E. W. Nelson, Dr. J. N. Rose and others. Attention was called to the occurrence of a species of Cichlid (*Heros urophthalmus*) in the cenotes or natural wells of Yucatan. These wells occur in a region where there is no surface water, and it is difficult to account for the presence of fish in them.

Mr. Nelson found this same species in salt water at Progreso and Mujeres Island, on the

Yucatan coast. The Cichlidæ are a family of fresh water fishes much resembling superficially our sunfishes (Centrarchidæ), and their occurrence in salt water had not been previously noted.

The discovery of a new species of catfish belonging to the genus *Conorhynchos*, in the Rio Usumacinta was also reported. No species of this genus was previously known from any point north of Brazil.

But the most interesting thing in connection with this bagre was the discovery that it has the habit of oral gestation, a curious habit not previously known to be possessed by *Conorhynchos*, though long known among species of South American and Ceylonese catfishes of the genus *Arius*.

When the eggs are laid they are taken up by the male catfish, who retains them in his mouth until they are hatched.

In the mouth of one of these catfish Mr. Nelson found thirty-nine eggs many of which readily rolled out when the fish was held up by the tail.

The eggs are quite large, measuring about three-quarters of an inch in diameter, and the embryos are well developed.

Another important discovery was the fact that *Girardinichthys innominatus* is ovoviviparous. This is a species of Pœciliidæ (killifishes) and was found by Dr. Rose to be an abundant inhabitant of the Rio Lerma. Its viviparity had not been noted before, nor was the species known to occur elsewhere than about the City of Mexico.

W. W. Cooke spoke on 'Some Untenable Theories of Migration,' stating that there were two theories as to the relative positions held by the individuals of a given species of bird in their winter home as compared with their positions during the breeding season. According to one theory the relative positions were the same, the birds moving southwards as one body, while according to the other theory the relative positions were reversed, those individuals which bred at the extreme north of the breeding range passing over the others, thus becoming the southernmost birds during the winter.

The Maryland yellow throat was given as an example of this latter method of migration, those individuals that breed farthest north going the farthest south in winter while the southern breeding birds remained almost stationary. But even here a complete reversal of position does not take place, for the intermediate breeding birds do not winter so far south as the southern breeder.

The red-winged blackbird, it was stated, did not follow either of the so-called rules and, in fact, each species seems to have a method of migration peculiar to itself, so that no general rule could be laid down that would cover even a large proportion of the different species. In most species, however, a reversal of position does occur during the early spring migration, but this condition does not last long.

F. A. LUCAS.

THE ELISHA MITCHELL SCIENTIFIC SOCIETY.

AT the 141st meeting of the Society, at the University of North Carolina, on April 15, the following papers were read:

'Arsenic Pentachloride': Mr. H. H. BENNETT.

'Copper Deposits of North Carolina': Dr. J. H PRATT.

'Price of Chemicals': Dr. CHAS. BASKERVILLE.

'Non-cellular Differentiation in Embryos': Dr. H. V. WILSON.

CHAS. BASKERVILLE,
Secretary.

DISCUSSION AND CORRESPONDENCE.

SCIENTIFIC TERMINOLOGY.

THE word 'ecology' is not to be found in recent English dictionaries, no doubt because such dictionaries do not profess to include every vagary of incorrect spelling that may find its way into print. But had Mr. Horace White looked up 'œcology,' he would have found it in the best dictionaries of the last fifteen years at any rate. He would not, however, have found the definition that is now given by you, but—to quote the 'Century Dictionary'—"The science of animal and vegetable economy; the study of the phenomena of the life-history of organisms, in their individual and reciprocal relations; the doctrine of the laws of animal and vegetable activities, as manifested in their modes of life. Thus, parasitism, socialism, and nest-building are prominent in the scope of œcology." Or, as Cassell's 'Encyclopædic Dictionary' (1886) concisely puts it—'The knowledge of the sum of the relations of organisms to the surrounding outer world, etc.' The word was, I believe, coined by Haeckel in his 'Schöpfungsgeschichte,' and must have been introduced into English in the translation of that work, which, being only about thirty years ago, is in a sense 'post-Darwinian' as you suggest. Haeckel and biologists generally have used the word in the above sense, but of recent years the botanists have wrested, or at least restricted, the meaning of the term to the study of the associations of plants in such groups as alpine, sand-dune, and desert plants; and this is the sense intended on pp. 458, 459 of SCIENCE for March 21. In a word, they have used 'œcology' instead of 'œcological plant geography.' This is rather different from your editorial explanation, which seems to apply equally to what pedants call 'chorology.' Perhaps I may refer those who wish to be interested to a clear and concise paper 'On the Study of Plant Associations' by Mr. Robert Smith in *Natural Science*, for February, 1899, though he does not mention the word 'œcology.' The botanists have about as much right to alter the meaning of the word as they have to alter its spelling. But the deed is done, and perhaps that is why zoologists have tried to replace the word in its original sense by such expressions as 'bionomics' and 'ethology.'

On the general question of scientific terminology (which is a different thing from nomenclature) I take this opportunity of endorsing Mr. Very's sensible remarks, and of recalling two further arguments in favor of a technical terminology based on Greek or Latin. First, its universality, since the words, with but slight modifications to adopt them to the genius of each particular language, may be used whether one be writing Russian or Roumanian, French or English, Portuguese or even German. The more extended the adoption of this technical terminology, the more easily will students of one country be able to read the scientific publications of other countries.

A curious illustration of this is afforded by the very sentence which Mr. T. A. Rickard (SCIENCE, January 24, p. 137) quoted as an abuse of geological terminology, intelligible to 'a traveling dictionary,' but not to the miners for whom it was intended. Without pretensions to fall into either of these categories, I found that the only words I did not understand in the sentence were two adopted from the miners themselves, and far removed from Greek and Latin. Secondly, such a terminology lends itself to the formation of analogous terms, of series of similar terms, and of compounds defining or extending the root-term, in a way that can be rivaled by few modern languages, certainly not by Anglo-Saxon English.

The other side to the question was admirably put by Mr. Rickard in the article already quoted, although he does not seem to discriminate sufficiently between technical scientific writing and the popular exposition of science. Huxley is constantly held up as an example, and those who would like to know how to treat of technical subjects in simple language are referred to 'the course of lectures delivered by Huxley to working-men.' But if Mr. Rickard will turn to Huxley's original scientific writings, he will find technical terms quite as abundant there as in the works of less lucid authors; indeed, every zoologist knows that Huxley took his fair share in the coining of new words. If this be clearly recognized by the readers of Mr. Rickard's article they will do well to take heed to his warning. For there is a temptation, stronger perhaps than ever before, to clothe simple ideas in a far-fetched jargon, and thus to impose on the credulous with a show of learning that hides a poverty or a looseness of thought. That fatal human habit of substituting words for things is made still more easy; and we deceive ourselves, which is far worse than deceiving others. Lastly, a subject of fascinating interest that might attract to the study of science many an expanding mind, or that might win the sympathy of the man whose life-work lies elsewhere (a sympathy which men of science profess to long for), is rendered sterile and repellent by the unnecessary use of unfamiliar terms. If I may without offense take a concrete instance, I would suggest that the author of the interesting note, 'Ecological Problems connected with Alpine Vegetation' (p. 459), might find it to the advantage of his subject, his audience and himself if he would rewrite his paper without using the words ecology (or œcology), phytogeography, morphology, floristic, edaphic, and xerophyte, or their derivatives.

F. A. BATHER.

BOTANICAL NOMENCLATURE.

TO THE EDITOR OF SCIENCE: It occurs to me after reading Dr. Cook's truly melancholy account of the condition of nomenclature in botany, to point out that the vast majority of the tribulations from which that nomenclature is suffering would be nonexistent if botanists had simply been willing to stand by the rules accepted by practically all zoologists. All the terrible examples he cites from Hernandez drop out of sight at once on the application of the rule that vernacular names are not to be accepted. Ninety-nine hundredths of the rest disappear with the fixation of 1758 ('Systema Naturæ,' Ed. X.) as the date beyond which resurrectionists shall not disturb the tombs.

It is true that all bodies of men contain a certain proportion of freaks and that some may be cited among zoologists, and a certain number of persons who have not made a study of nomenclature as an art, persist in injecting sentimental considerations into their argument and practice.

But these as a rule have not succeeded, in this country, in disturbing systematic work or diverting attention from the goal of stability which most zoologists aim at.

With an international committee to decide the fate of the residue of preposterous names which no rules can eliminate, I think a comparatively few years would put zoological nomenclature on a solid and permanent basis. And if botanists would 'hark back' to De Candolle and rigorously apply his rules, they also might see the dawn of a better day.

WM. H. DALL.

SMITHSONIAN INSTITUTION,
April 26, 1902.

THE WILL OF THE PEOPLE, NOT OF AN OLIGARCHY.

PROFESSOR WILLIAM T. SEDGWICK, of Boston, in an address published in SCIENCE, January 10, 1902, 'confesses with sorrow' the lack of success of efforts to prevent the study of 'temperance physiology' as now required in the public schools of this country.

He first offers in defense of his opposition the fact that Horace Mann, in 1842, did not include temperance physiology in his essay on 'The Study of Physiology in the Schools,' but he omits to add the significant accompanying fact of history, namely, that the recommendations of Horace Mann's essay that 'physiology should be taught in the schools,' aroused in Massachusetts such a storm of bitter opposition from the doctors and men of official science, that the existence of the Massachusetts State Board of Education and its secretary, Horace Mann, were saved by only a hair's breadth from being entirely legislated out of office. But time has vindicated Horace Mann's recommendations, while his opponents are forgotten.

Sixty years have passed and Massachusetts, as well as every state in the United States and the National Congress, has made physiology and hygiene, which latter includes the nature and effects of alcoholic drinks and other narcotics, a mandatory public school study. Professor Sedgwick is now objecting, not to this study, he says, but to the legal specifications which have made it a success. First he objects to its being taught 'to all pupils.' He does not tell when or by what class of pupils he would have it omitted. In our country 'all pupils' of to-day are destined to be the sovereign people of to-morrow. Hence, looked at from the standpoint of the state, it can not afford that one single pupil should not receive the utmost instruction on this subject needed to fit that pupil for a future sovereignty of intelligent sobriety.

From the standpoint of the individual, we ask, From whose child shall this educational method for the prevention of intemperance be withheld? Shall it be from the children of the poor, the rich, the foreign-born or the home-born? We are answered by the command of the greatest of all teachers that the supreme message for the prevention of evil and the establishment of right should be given 'to every creature' in 'all the world.' That inclusive command and precedent not only justify all pupils getting this education, but imply neglect of duty if it is excluded from any.

If Professor Sedgwick's objection is to the requirement of the study through specified grades, as his reference to the Illinois law implies, we answer:

The formation of right habits is the object sought. The child's habits are rapidly formed, new ones each year. It is therefore self-evident that progressive instruction which will guide in the formation of right habits should be given, especially during the primary and grammar years and the first year of the high school, in order to keep pace with and guide the child's development. The boy or girl who leaves school at any point in the school course with as much knowledge as he can comprehend of the laws of health, including those which warn against the use of alcoholic drinks and other narcotics, has thereby a most valuable equipment for the battle of life.

The diffusion of this knowledge in our country is now as universal as the schools. It does not, we grant, add to the value of brewing stock, but evidence is not lacking that it is proving of great value to the human stock in the increase of health due to better knowledge of sanitary laws, consequent lengthening of life, increased sobriety of the American workman, which sobriety is acknowledged to be one cause of the commercial supremacy of this country in the markets of the world, etc.

Professor Sedgwick says he was 'shocked,' 'much disturbed to find that an author had actually felt bound to weave in a lesson on alcohol with his discussion of the physiology of muscle, of nerve, of digestion, of vision and each of several other sections of the subject.'

Why should not the deleterious effects of alcohol on muscles be taught in connection with the study of the physiology and hygiene of the muscles? Professor E. Destrée, M.D., University of Brussels, by actual experimentation proved that the 'total work product obtained from the muscle with the use of alcohol is less than that obtained without it.' Our boys and girls need to know this fact. Why should not the fallacy of the idea that alcohol is an aid to digestion be pointed out in connection with the hygiene of digestion, when Professor Chittenden (one of the Committee of Fifty) distinctly says of his experiments, 'The results obtained suggest a tendency toward prolongation of the period during which the meat remains in the stomach when alcohol fluids are present'? Why is not the treatment of the physiology and hygiene of the nerves the proper place for pointing out the effects of alcohol upon them when H. J. Berkeley, M.D., of Johns Hopkins University, reported as a result of the experiments he performed for the Committee of Fifty that alcohol 'possesses the quality of destroying the protoplasm of the nerve cells and annulling its functions'? Why not, in teaching the care of the eyes, mention the danger from the use of alcohol when the senior surgeon of the New York Ophthalmic Hospital, editor of the *Journal of Ophthalmology,* says, 'The respectable moderate drinker who never takes too much or oversteps the boundary line of decency, but goes round half full all the time, exposes himself to the risk of losing his eyesight, which in this case is incurable'?

To Professor Sedgwick's complaint that some laws require text-books on this subject for pupils' use and specify the amount of temperance matter they shall contain, etc., we reply:

The tendency of careless, unsympathetic school boards to fail in providing well-graded text-books on this subject, books that contain the matter the law requires taught as one source of information for pupils sufficiently advanced to use text-books on other subjects, induced the National Congress and many states legally to require that such text-books shall be provided. This requirement has led to the preparation of a valuable school literature by men of acknowledged scientific standing and to the revision of nearly all the imperfect books. Why should Professor Sedgwick complain? No one has proved these books inaccurate, nor that their use in the schools has not contributed to individual and public good. The old, unrevised, ungraded, and therefore unindorsed books contain such teaching as the following, for children in primary grades: 'The tendon of Achilles is the tendon of the gastrocnemius and soleus muscle,' a statement as clear as mud to the primary child. The people want better books for their children and hence have so legislated that better books are produced.

Professor Sedgwick further charges me with being a follower of the teachings of Sir Benjamin Ward Richardson, M.D., of London (whom he styles an 'able but erratic physician') and with being 'the creator of this astonishing movement' for temperance education. The late Dr. Richardson was not only a Doctor of Medicine, but a Doctor of Laws and Fellow of the Royal Society and held many offices of distinction. I happened to have had enough previous study in chemistry to enable me to appreciate the reports of his experimental work on alcohol, and no one has proved his findings inaccurate. Although I never saw Dr. Richardson, he taught me much which I have tried to pass on.

As to being the 'creator' of this movement, I do not deny nor apologize for having tried to serve my country through helping to get this education for its children. But I hasten to say that without the aid of the hundreds of thousands of consecrated women in the Woman's Christian Temperance Union, the organized motherhood of this and other lands, whom it is my fortune to represent in this matter, without the cooperation of the good men in this and other countries, in the National Congress, state legislatures and parliaments, every state in the United States would not now have a temperance education law nor would the movement have become, as Professor Sedgwick admits, world-wide.

Professor Sedgwick, in referring to Commissioner Harris' connection with the advisory board of this department, says: 'As to the propriety of the commissioner's connection with this movement I make no comment.' The advisory board of this department consists of eleven members, six of them physicians, three of whom are professors in medical colleges, three men eminent in education and two in ethics. The committee from this advisory board, whose duty it is to examine and pass on text-books, consists of five of the physicians mentioned above, one of the educators, two representatives of ethics, and the Superintendent of Scientific Temperance Instruction of the World's and National Woman's Christian Temperance Union. Dr. Harris, the National Commissioner of Education, and Dr. Barrows, President of Oberlin College, members of the advisory board, are not on its text-book committee. Hence there is no occasion for Professor Sedgwick's subtle reference to Dr. Harris' position on this board. The American people will feel it just and right that their national commissioner of education should be an adviser of a department of education which has been legally adopted by the whole people.

If Professor Sedgwick had quoted entire the recommendations passed by the Superintendents of Schools at their national meeting in Chicago last year, the readers of SCIENCE would have seen that their action was positively on the side of temperance instruction, and not mere 'guarded paragraphs' as he claimed. They repudiated Professor Atwater's teachings of the year before as to alcohol being a food, and put themselves squarely on record on the whole subject as the following paragraphs from their report, not quoted by Professor Sedgwick, show:

"The department of superintendence agrees cordially with the special advocates of the temperance cause in holding that everything which public instruction can do in the battle against intemperance ought to be done, and that both physiology and hygiene should be so taught as to leave in the minds of children and youths an adequate and proper knowledge of the effects of alcoholic drinks, stimulants, and narcotics on the human system.

"Since the last meeting of this department there has been considerable discussion of the question as to whether alcohol under any conditions is properly to be defined as an article of food. Medical authorities are quoted in support of both sides of this question, but no authority has been found to maintain that alcohol is a food in the ordinary sense of that term. The question of the supposed food value of alcohol is a technical one for medical experts to determine, and not one which needs to concern the men and women who are engaged in the work of public instruction of children and youth. For them it is enough to know that its use as a beverage is injurious, and that all authorities agree in deprecating the formation of the drinking habit and in commending all practicable efforts through public instruction to promote the cause of temperance."

Professor Sedgwick appears to have fears that a writer who desires to publish an elementary text-book on physiology and hygiene, before he can obtain a publisher or a market may have to secure the indorsement of Mrs. Mary H. Hunt, etc.

Anybody can write a text-book on this subject as far as the Scientific Department of the Woman's Christian Temperance Union is concerned, but the mothers in any community have a perfect right to oppose their children studying that book, if, in their judgment, it fails to teach the whole truth against the most destructive of human habits. They have a right through organization to secure and protect this form of education for their children, and to appoint one of their number to act with them in searching for truth, and, aided by men of science, to refuse indorsement to books that do not contain the truth. I make no apology for its being my fortune to have been thus officially appointed, and woe is me if in this I fail in aught of my utmost duty, for history will show that organized motherhood in securing and protecting this education for all the children of this nation has prevented the greatest peril to our government of the people, namely, the lack of capacity for self-government resulting from the use of alcoholic drinks and other narcotics.

As to the publisher's part, I would say in this connection: The publisher is a business man who knows that his success depends upon his supplies meeting the demands of the market. If the condition prevails which Professor Sedgwick describes, it is good evidence that publishers have found that the American people do not want their children to study what the publishers themselves call 'rum books,' and that the indorsement of this department is a guarantee to the public that the books bearing that indorsement are not of that character, but instead contain the truths the people want taught their children. Therefore, the writer who wishes to put a 'rum book' upon the market must find publishers who will ignore the law of supply and demand; or he must persuade the people to allow their children to be sacrificed to the Moloch of intemperance, either for his personal gain or to avoid shocking the sensibilities of scientific gentlemen who see no place in physiology and hygiene for warning against that disobedience of hygienic law which causes, as Gladstone said, more havoc to the human race than war, pestilence and famine.

No man has ever yet been able to present a reasonable argument for opposing the temperance education movement. The brewers and distillers of course can not imagine any other than a financial motive that could induce the devotion and labor that have brought this movement to its present position in this country and the world. Hence they charge, and have from the first, that it is a 'book job.' And in the absence of reasonable objection other opponents reiterate this liquor dealers' charge. Professor Sedgwick falls into line with them when he attempts to support his objection with a quotation from a letter written, he says, by a representative of a publishing house which charges that 'financial benefit' is the motive of the temperance physiology movement. On reading that, I at once wrote Professor Sedgwick asking for the name of his informant and whether that informant had submitted any evidence in support of his statement. Professor Sedgwick replied that he did not feel at liberty to give the name of his informant who, he says, 'did not submit any evidence bearing upon his opinion.' In other words, Professor Sedgwick makes this accusation public without examining the evidence for the same and without knowing, so far as he reports, whether any such evidence existed. If the man who made this charge is reliable, why should he be unwilling that Professor Sedgwick should mention his name? As to the intimation of a mercenary motive, neither I, nor my advisory board, nor the constituency we represent are one penny richer for the sale of any text-book on this subject bearing our indorsement. Resort to such charges is evidence of conscious poverty of argument against this movement. As to the promoters of temperance education in the public schools being a 'self-constituted oligarchy,' as Professor Sedgwick says, we reply:

The Superintendent and Advisory Board of the Department of Scientific Temperance Instruction in Schools and College represent the World's and National Woman's Christian Temperance Union in their oversight of the study of temperance physiology in schools. Thus this department has for its constituency the largest organization of women in the world, who are banded together to secure, as one of their objects, the protection of this special education for their children. Hence, to call the work of this department that of a 'self-constituted oligarchy,' as Professor Sedgwick does, shows utter misapprehension of facts. 'A self-constituted oligarchy,' *i. e.*, 'power exercised by a few' who are self-appointed, could not write its ideas embodied in law on the federal statute books and those of all the states of this great republic. The laws requiring this study and whatever is necessary to its being taught represent the 75,000,000 American people who have decided that their children shall have this special education. It is simply futile to try to belittle this movement by efforts to make it appear as anything less than a national one which is rapidly becoming world-wide.

MARY H. HUNT.

World and National Superintendent of the Department of Scientific Temperance Instruction of the Woman's Christian Temperance Union.

TEMPERANCE PHYSIOLOGY IN THE PUBLIC SCHOOLS.

TO THE EDITOR OF SCIENCE: Mrs. Hunt apparently sees no impropriety in a law which requires temperance physiology, so called, to be taught to 'all pupils' in the public schools. If it does not seem to Mrs. Hunt, as it does to me, obviously undesirable and improper to require such teaching of children in the primary and kindergarten grades, then I fear that nothing that I can do is likely to bring us into agreement.

Mrs. Hunt has much to say about 'organized motherhood,' by which she seems to mean the so-called 'consecrated women' in the Woman's Christian Temperance Union, and her letter may give the impression that it is not she but they, who have been chiefly instrumental in the text-book movement, etc., especially as she affirms, 'I make no apology for its being my good fortune to have been thus officially appointed.'

Although it is difficult to discover from the context to what exactly she was thus 'appointed,' a reference to Mrs. Hunt's quasi-historical documents cited in my Chicago address, and entitled 'An Epoch of the Nineteenth Century,' and 'A Brief History of the First Decade,' throws light upon this somewhat obscure statement; for upon page 6 of each of these documents Mrs. Hunt states that the 'Woman's Christian Temperance Union was organized in 1874,' and "In the autumn of 1879 I carried to the annual national convention of the Woman's Christian Temperance Union in session in Indianapolis, Indiana, what the Quakers would call 'my concern,' for thorough text-book study of scientific temperance in public schools as a preventive against intemperance. * * * A standing committee, of which I was made chairman, was chosen. * * *

"The idea of scientific temperance instruction as a part of the regular course of study in public schools was thus adopted by an organization [the Woman's Christian Temperance Union]. * * * Resolutions were passed and action taken which resulted in 1880 in the creation by that organization of a department to work for scientific temperance instruction in public schools and colleges, of which department I was made superintendent. * * *

"While this new affiliation brought neither help in methods nor the financial aid greatly needed for the execution of plans, it did furnish what was still more necessary, an earnest, enthusiastic clientage of active loyal Christian women, in every part of the country, ready gladly and intelligently to carry out the plans transmitted to them. * * * Napoleon Bonaparte would never have been the Napoleon of history if he had had no army."

Mrs. Hunt's allusion to Napoleon is unfortunate, for how Bonaparte was 'officially appointed' to rule over his army we all know.

I must admit that my term 'self-constituted and official oligarchy' was apparently not strictly accurate; and I confess myself at a loss for the right term; 'monarchy' or 'dictatorship' might perhaps fit the case better, but would probably not meet with Mrs. Hunt's approval; and I find her term 'organized motherhood' also open to objection.

As to the statement, 'Professor Sedgwick falls into line with them [that is the liquor dealers] when he attempts to support his objection with a quotation from a letter written, he says, by a representative of a publishing house,' I desire simply to recall what I actually did say, which was that the letter quoted by me constituted an 'opinion,' merely, the existence of which seemed to me noteworthy and unfortunate.

Finally, I may say that I shall be happy to send a copy of my Chicago address to any one who is unable to refer to it in Science of January 10.

W. T. Sedgwick.

SHORTER ARTICLES.

PRELIMINARY OBSERVATIONS ON A SUBDERMAL MITE OCCURRING AMONG THE BIRDS IN THE NEW YORK ZOOLOGICAL PARK.

During the month of February, 1901, four white ibises (*Guara alba*) died in the bird-house of the New York Zoological Park, and neither gross nor microscopical examination showed pathological evidence sufficient to account for the death of the birds, but on beginning to skin a fifth ibis, two peculiar patches were observed on the under surface of the skin on each side of the keel of the sternum. At first glance these looked as a heron's skin does, beneath powder-down patches, where the ends of the tiny quills are plainly visible, all pointing in one direction. A closer examination showed these patches to consist of many hundreds of small mites, close together, all lying lengthwise. A yellowish exudation and a small amount of watery matter was observed in the vicinity of these patches.

During the early months of 1901, a number of other birds died from the ravages of this peculiar pest. Two valuable great-crowned pigeons (*Goura coronata*) showed, besides large numbers of these mites, numerous oval parasites in the red blood-cells. A little blue heron (*Ardea cærulea*) and several Nicobar pigeons (*Calœnas nicobarica*) had congested lungs and large numbers of the mites.

The present winter, only two birds have died from this cause, although the mites have been detected in two living birds. In a white ibis which succumbed, the parasites were smaller and less numerous than in the birds of the same species which died last winter. The second bird which died was a roseate spoonbill (*Ajaja ajaja*), in which the mites were large and numerous.

The mites vary greatly in size and appearance, but the largest individuals are 1.50 mm. in length and about .50 mm. in breadth. Eight five-jointed legs are present, four near each end of the longish-oval body. The most noticeable characteristics are the brownish, probably chitinous, leg-supporting structures which vary in complexity with the size of the individual. In a small specimen these are comparatively simple, while in mites of larger size they ramify into complex structures. Six of the legs bear numerous short hairs, while two at one end of the body end in a single long bristle.

The temperature of the bird-house has been kept quite low during the present winter, with distinctly beneficial results to the birds, and this may also account for the absence or small size of the mites.

Drawings have been made of specimens and, although distinct, the organism most resembles the worm-shaped pigeon mite (*Hypodectes columbarum*) superficially described by Dr. Anton Zürn in 'Die Krankheiten des Hausgeflügels.'

He evidently knows but little about the mite, but quotes from Megnin and others and gives one or two rather suggestive hints which it is expected will soon be worked out by experiments among the birds in the New York Zoological Society's collection.

Speaking of this mite, Zürn says: "Wohnort. Im Unterhautzellgewebe, ferner im Bauchfell, in den serösen Überzügen der Eingeweide, in dem Bindegewebe, welches die grösseren Blutgefässe, namentlich die Aorta, umgibt, bei Tauben und einigen wildlebenden Vögeln." In all the birds which have come under my observation the mites have been absolutely confined to an irregular patch on each side of the breast-bone.

Another paragraph of interest follows: "*Hypodectes columbarum* ist keine fertig entwickelte Milbe, sondern die Larve einer solchen. Megnin hält sie für die Nymphe einer ungekannten Milbe, wahrscheinlich eines *Pterolichus*. Der genannte Forscher will eine solche wurmförmige Larve oder Nymphe auf einem sich mausernden Vogel beobachtet haben, wie sie in die klaffenden Follikel der ausgefallenen Federn eindrang; * * * Ist die Mauser vorüber, dann nehmen die Nymphen die normale Form an, indem sie sich aus ihren Hüllen befreien und auf die Oberfläche der Haut wandern."

This subdermal form may be the immature stage of an arthropod with incomplete metamorphosis, and as the birds afflicted had passed their moult, the fact that entrance was gained through a gaping feather follicle is not impossible. The hairs on the legs of these organisms would certainly seem to suggest that part, at least, of their existence is spent where these would be of more use than in an inch or two of subcutaneous tissue.

In two living ibises incisions in the skin of the breast were made, and by pushing the skin back and forth near the pectoral muscle, to which it is so loosely attached, a number of very small mites were 'teased' into view, but these birds have shown no ill effects from them.

If the ravages of these mites ever become again troublesome, the treatment suggests itself of injecting or applying some liquid inimical to parasites, as iodine, during the moulting of the birds which seem to be particularly susceptible.

Attempts to inoculate pigeons have not thus far been made, as in dead birds the parasites have been also without life, and the living birds which have been examined have been too valuable to warrant any extensive incision for the purpose of obtaining living mites.

C. WILLIAM BEEBE.

March 18, 1902.

NOTE ON DISCORBINA RUGOSA D'ORBIGNY, FROM PROVINCETOWN, CAPE COD.

THROUGH the courtesy of Professor J. Henry Blake, of Harvard, the writer recently received a number of specimens of Foraminifera from various localities. Among this material was some shore sand from Provincetown, Cape Cod, Mass., which contained a large number of foraminifera. Upon examination these were found to belong to a single species, namely *Discorbina rugosa* d'Orbigny.

The species is a particularly interesting one, since it does not appear to be at all common at the present time. The *Challenger* Expedition obtained the species from only two stations: off Papua, near Raine Island, depth 155 fathoms, and off Ki Island, 580 fathoms.

D'Orbigny in his report in 1839 on the Foraminiferes American Meridonale, described the shell under the name *Rosalina rugosa* from the Bay of St. Blas, Patagonia.

In the 'Challenger Report' Brady describes the shell as follows: "A more or less explanate modification of *Discorbina* resembling *Anomalina ammonoides* in general contour. The test is compressed and exhibits some approach to bilateral symmetry, and the peripheral edge is round and lobulated. The umbilical cavity of the inferior side is partially covered in by valvular flaps protecting the successive apertures."

This shell is very abundant in the Cape Cod shore sand at Provincetown, but the writer was unable to find a single specimen in some material submitted from Woods Holl. A more thorough examination may perhaps reveal the shell in other localities along the Atlantic coast, but it is probably confined to northern waters. Our specimens are large, well developed, of a dark brownish color and in a state of perfect preservation.

RUFUS M. BAGG, JR.

BROCKTON, MASS.

THE PROPER NAME OF THE ATLANTIC BOTTLENOSE WHALE.

The binomial long applied to the 'bottlenose' of the Atlantic Ocean and currently accepted by modern authors is *Hyperoodon rostratus* (Muller), described and named *Balæna rostrata* by him in 1776 in the 'Zool. Dan. Prodr.,' p. 7. This appears to be antedated six years by *Balæna ampullata*, a name proposed for the same animal by John Reinhold Forster in the 'Linnæan Travels' [Kalm], 1770, Vol. 1, p. 18, footnote. In this Forster criticizes Kalm for calling the 'bottlenose' a dolphin, because 'it has no teeth in its mouth as all the fish of that class have.' He then refers to "Mr. Pennant's 'British Zoology,' Vol. 3, p. 43, where it is called the beaked whale and very well described," adding, "a drawing is seen in the explanatory table, n. 1. Perhaps it would not be improper to call it *Balæna ampullata* F." In the 1812 edition of Pennant's 'British Zoology,' Vol. 3, p. 85, this 'beaked whale' or 'bottle head' is properly classed under Lacepede's genus *Hyperoodon*. From the foregoing I conclude the proper name of this whale to be *Hyperoodon ampullatus* (Forster). Samuel N. Rhoads.

Audubon, N. J.,
March 19, 1902.

CURRENT NOTES ON METEOROLOGY.

LOSS OF LIFE IN THE UNITED STATES BY LIGHTNING.

The Weather Bureau has, since 1890, conducted a statistical inquiry into the number of deaths and of injuries caused by lightning in the United States. This work has been carried on up to the close of 1900, when it was discontinued. During the year 1900, 713 persons were killed by, or received fatal injuries through, lightning. Of this number 291 persons were killed in the open, 158 in houses, 57 under trees, and 56 in barns. The circumstances attending the deaths of the remaining 151 are not known. During the same year 973 persons were more or less injured by lightning strokes. On the average, it is probable that from 700 to 800 lives are lost each year by lightning in the United States. Tabulating the average mortality resulting from lightning according to geographic districts subject to the same, or nearly the same, atmospheric conditions, it appears that the greatest number of fatal cases occurred in the Middle Atlantic States; the next greatest in the Ohio Valley and Tennessee, with the middle and upper Mississippi Valley a close third. The greatest number of deaths in any single state during the five years 1896-1900 occurred in Pennsylvania (186), followed by Ohio with 135, and Indiana, Illinois and New York with 124 each.

In the Gulf States the average number of deaths due to lightning per unit area (10,000 square miles) is 1. In New England, with probably half as many thunderstorms, the death rate per unit area is 2. In the latter district the death rate per million of rural inhabitants is nearly double that per million of total population, and the same holds true of the densely populated districts of the Middle Atlantic States. Considering both unit area and density of population, the greatest mortality by lightning is in the Ohio Valley and the Middle Atlantic States. If, however, the density of population alone be considered, it is in the upper Missouri valley and the middle Rocky Mountain region.

The foregoing facts are taken from Bulletin 30, of the Weather Bureau ('Loss of Life in the United States by Lightning,' by A. J. Henry), in which will be found further interesting information, as well as a chart—the first of its kind for this country—showing the geographic distribution of deaths by lightning in the United States.

TEMPERATURE, RAINFALL AND SUN-SPOTS IN JAMAICA.

Maxwell Hall returns to the subject of the relation between sun-spots, temperature and rainfall in a recent paper entitled 'Temperatures in Kingston, Jamaica, and the Connection between Sun-Spot Frequency, the Mean Maximum Temperature, and the Rainfall in Jamaica' (Kingston, 1902, 12 pp.). Using the observations of 1881–1898, inclusive, and taking the mean maximum temperatures of any three years as the mean of the middle year, the plotted curve of mean maximum temperatures agrees remarkably closely with the curve of sun-spot frequency. There are about 2° in mean maximum temperature between the maximum and minimum of the sun-spot curve. The rainfall curve also accords as a whole remarkably closely with the sun-spot curve, but from the middle of 1887 to the middle of 1890 the rainfall was less than it should have been, and from the middle of 1891 to the end of 1895 it was greater than it should have been. These irregularities are interesting because in 1892 it was assumed that the curve would recover its position, and a smaller rainfall for the next few years was predicted, but 1893 proved to be unusually wet.

CLIMATE OF WESTERN AUSTRALIA.

CLIMATOLOGISTS will give the latest publication from the Perth Observatory a warm welcome, for it is the first comprehensive report on the climate of western Australia. Annual meteorological summaries have been issued since 1876, but the present volume comprises a selection and coordination of the principal meteorological facts which have been discovered during the past twenty-four years of observations. 'The Climate of Western Australia from Meteorological Observations made during the Years 1876-1899' is the title of this publication, and it reflects great credit on Mr. Ernest Cooke, Government Astronomer for Western Australia. Naturally, meteorological work has been carried on under the greatest difficulties in the district in question, and the earlier records cannot be compared as regards accuracy with those which are now being made.

It is a great satisfaction to note that Mr. Cooke gives at the very beginning of his report a series of seventeen weather maps illustrating the weather types of the district under discussion, for the best understanding of a climate is to be gained through an appreciation of the local weather types. There are two principal types of weather, the winter and the summer, although each of these is, of course, subject to endless modifications. A general, albeit very brief, description of the climate follows the discussion of the weather types, the statements having special reference to Perth, and a full set of meteorological tables completes the volume. A table of special interest is that which shows the duration of the 'heat waves' which have passed Perth since January 1, 1880. The longest of these spells without a break occurred in 1896, when the maximum temperature exceeded 90° on every day between January 25 and February 12—nineteen days in all, but the most severe heat was apparently in January and February, 1880, when the maxima on several days rose over 100°, and on two days over 110°. It may be noted, however, that hot nights are exceptional, even during these hot waves, the minima being usually between 60° and 70°. A series of charts accompanies the volume, showing, for each month and for the year, the pressure; mean, maximum and minimum temperature, and the rainfall.

R. DEC. WARD.

HARVARD UNIVERSITY.

SCIENTIFIC NOTES AND NEWS.

THE Academy of Sciences at Christiania has elected the following corresponding members: Dr. J. H. van't Hoff, professor of general chemistry, and Professor Adolf Engler, professor of botany, at the University of Berlin; Dr. Richard Abegg, professor of chemistry at Breslau; Dr. Karl A. Ritter von Zittel, professor of paleontology and geology at Munich, and Dr. Julius Hann, professor of meteorology at Vienna.

McGILL UNIVERSITY has conferred the degree of doctor of science in course on Professor Frank Dawson Adams, M.A., Ph.D., Logan professor of geology and paleontology, McGill University, and on William Bell Dawson, M.A., Ma.E., of the Department of Marine, Ottawa.

GLASGOW UNIVERSITY has conferred its LL.D. on Mr. James Stevenson, of Largs, for his services in opening up Nyassaland and in establishing the Livingstone mission by which the work of Dr. Livingstone was continued and brought to fruition, and in the completion of the great highway between Lake Nyassa and Tanganyika, known as Stevenson-road.

PROFESSORS VICTOR C. VAUGHAN and Frederick G. Novy of the medical department of the

University of Michigan will leave for Asia about the middle of June to investigate tropical dysentery.

We regret to learn that President Henry Morton, of Stevens Institute of Technology, Hoboken, has suffered a relapse following the surgical operation he underwent on April 15.

Mr. William S. Weedon, L.B., Maryland Agricultural College, 1897, assistant in chemistry at the Johns Hopkins University and a candidate for the doctorate of philosophy in June, has been appointed research chemist of the General Electric Company, Schenectady, N. Y.

Dr. F. A. Bather has been promoted to the assistant keepership of the Department of Geology in the British Museum (Natural History).

Professor Charles Aurivillius has been elected permanent secretary of the Royal Academy of Sciences at Stockholm, and Dr. Yngve Sjöstedt has been made professor in the Academy and custodian of the entomological department of the Museum of Natural History.

Sir William Roberts-Austen gave the tenth James Forrest lecture before the Institution of Civil Engineers of London on April 23, his subject being the 'Relations between Metallurgy and Engineering.'

During the coming season four field parties will be sent out from the department of vertebrate paleontology of the Carnegie Museum at Pittsburg, Pa. These parties will be under the general direction of Mr. J. B. Hatcher, and will be assigned as follows: One under the direct charge of Mr. Peterson will continue the exploration of the Tertiary deposits of northwestern Nebraska; a second, in charge of Mr. C. W. Gilmore, will carry on the work in the Jurassic deposits on Sheep Creek, Wyoming, where such excellent results have already been obtained by this museum during the past three years; a third, with Mr. W. H. Utterback in charge, will work in the Laramie of Wyoming and Montana; while Mr. Earle Douglass, who has recently been engaged by this museum, will undertake a systematic exploration of the various Tertiary horizons discovered by him in western Montana. It is proposed to continue Mr. Douglass in this field until he has accumulated sufficient material and data to enable him to definitely correlate the various horizons and to monograph the fauna of each.

Nature states that the meeting of the Paris Academy of Sciences on April 14 was adjourned as a sign of respect for the late Professor A. Cornu, whose untimely death was announced by the president in the following words:

The Academy of Sciences has suffered a great loss. Professor Cornu died on Friday, carried away rapidly by a disease which no one could foresee would terminate so sorrowfully. Our colleague was relatively young; he entered the École Polytechnique in 1860 and was nominated a member of our Academy in 1878, at thirty-seven years of age. Esteemed as a professor at the École Polytechnique, and contributing to the Bureau des Longitudes every year notices written in perfect language, he died while in active scientific work, leaving saddened parents and friends behind him, and universal regret in the scientific world.

We regret to record the deaths of Dr. Alexander Bittner, chief geologist in the Imperial Geological Institute at Vienna, and of Dr. Egon Müller, docent in physics at the University at Erlangen.

The astronomical library and collection of photographs, drawings, etc., belonging to the late Miss Catherine M. Bruce, to whom astronomy was indebted for many generous gifts, has been presented to the Allegheny Observatory by her sister, Miss M. W. Bruce.

A despatch from Wellington says the government has provided $5,000 for an antarctic relief ship.

The first conversazione of the Royal Society for this session will be given at Burlington House on Wednesday, May 14, at 9 p.m.

The agricultural experiment station of the University of Illinois in cooperation with the Bureau of Soils of the U. S. Department of Agriculture is beginning an agricultural survey of Illinois soils. A field party is now at work in Tazewell County. In conducting the survey the ground is gone over carefully and the soil is examined to a depth of from three to six feet, samples being obtained by boring with augers. Soil maps will be made which will show the area and location of all the different important types or classes of soil in the land surveyed.

THE commission authorized by the late New York legislature to report on the establishment of a state electrical laboratory, met at Albany on April 29.

IT has for some time been understood that the Louisiana Purchase Exposition at St. Louis will not be held before 1904, and the executive committee has requested congress to change the time of the exposition from 1903 to 1904.

THE nineteenth annual meeting of the American Climatological Association will be held at Los Angeles, Cal., on June 9–11, under the presidency of Dr. Samuel A. Fisk, of Denver.

THE Easter vacation party at the Port Erin Biological Station, says *Nature,* has suffered by the absence abroad of Professor Herdman and Mr. I. C. Thompson, so that it was not possible to arrange any steam dredging expeditions. Nevertheless, much good work has been done on the shore and with the townet, and several workers have spent a profitable vacation at the station. These include Dr. Darbishire, Miss Pratt and Miss Drey from Owens College, Messrs. Pearson and Tattersall from University College, Liverpool, and Mr. Laurie from Oxford. Mr. Cole was to have conducted a vacation class, but was unable to cross owing to a family bereavement. The new and greatly improved station is progressing rapidly and will be opened in the summer.

MUCH additional material from the A. J. Stone Expedition to Alaska has been received recently by the American Museum of Natural History among which there are specimens of what proves to be a fine new species of caribou and a new species or subspecies of mountain sheep. This expedition is the first of a series made possible through the efforts of Madison Grant, Esq., and supported by him and other friends of the Museum, for the purpose of securing an adequate representation of the game mammals of the continent. The past season's work has been especially important because it has provided material from Alaska, a portion of America heretofore practically unrepresented in the collections.

NEWS has been received to the effect that the expedition headed by Mr. W. F. Whitehouse of Newport, R. I., who is accompanied by Lord Hindlip, reached Gildessa on the Abyssinian frontier, on March 23, with the members in good health, and proceeded to Adis Abeba, capital of Abyssinia.

PLANS for the auxiliary Baldwin-Zeigler expedition to northern polar regions have been completed and the men who have been intrusted with its direction will shortly leave for Europe. The steamer *Frithjof,* which with the *America* conveyed the Baldwin party to Franz Josef land, will depart from Tromsöe on July 1. The auxiliary expedition will be in charge of Mr. W. S. Champ, secretary to Mr. William Zeigler, who will sail for Europe on the steamship *Cymric* on May 23, and the remainder of the party will leave on the steamship *Pretoria* on June 7.

THE Horticultural Society of New York will hold its third annual meeting at the New York Botanical Garden on May 14. Members and their friends leaving Grand Central station by the 1:35 P.M. train for Bronx Park, will be met at the station by Mr. James Wood, president of the Society, and escorted to the conservatories. Those leaving Grand Central Station by the 2:35 P.M. train will be met by Dr. D. T. MacDougal, first assistant, New York Botanical Garden, and escorted to the conservatories. Leaving the conservatories at 3:35 the party will walk through the grounds to the museum building; the formal meeting will commence in the lecture hall of the museum building at 4:15 o'clock and will be followed by an exhibition by Dr. N. L. Britton, of lantern slides illustrating 'Features of the New Zealand Flora,' contributed to the Garden by Mr. L. Cockayne. The Council of the Society will meet in the administration office, museum building, at 3:15 o'clock. The museum, library, herbarium, and laboratories in the museum building will be open for inspection until 6:30. An exhibition will be held in connection with the meeting, in the hall of the museum building immediately adjoining the lecture hall; this exhibition will be open from one o'clock until half past six on Wednesday, May 14, and from ten o'clock until five on Thursday, May 15.

UNIVERSITY AND EDUCATIONAL NEWS.

Adelphi College, Brooklyn, has received gifts amounting to $250,000, of which one half was given by Mr. John D. Rockefeller.

Mr. Henry C. Havemeyer has given two thousand volumes to the library of the public school at Greenwich, Conn., erected by him and Mrs. Havemeyer at a cost of $200,000.

Three of the positions offered by the Harvard Medical School to properly qualified men desirous of training in physiological research and in the management of large laboratory classes in experimental physiology are not yet filled for the next collegiate year. Holders of these positions give more than half the day to research. The remaining time is spent during the first four months of the collegiate year in learning laboratory methods and during the last four months in directing the laboratory work of the medical students, about two hundred of whom work from two to three hours daily for sixteen weeks in experimental physiology. The fundamental experiments in physiology done by so many men working at one time present every variety of results and impart a training not to be acquired in other ways. Much too may be learned by association with the large staff engaged in research in the laboratories of anatomy, histology, pathology, pharmacology, hygiene, physiology and physiological chemistry, all of which have their laboratories in the Medical School building. No charge of any kind is made either for the training in physiological research and in teaching or for the use of animals and other material. In addition to these opportunities each assistant receives four hundred dollars. Applications for these positions should be sent to Professor W. T. Porter, Harvard Medical School, 688 Boylston Street, Boston, Massachusetts.

The Hon. Carroll D. Wright, commissioner of labor, has been appointed president of the collegiate department of Clark University. It is understood that Mr. Wright will not, for the present at least, resign his position under the government or his work at Columbian or Catholic University.

Dr. Frank Strong, formerly president of the University of Oregon, has been elected chancellor of the University of Kansas.

It is expected that General Webb, president of the College of the City of New York, will retire from his office at the end of the present year. Arrangements have this winter been made by which the officers of the College retired for age shall receive a liberal pension. The report that Dr. W. H. Maxwell, superintendent of public schools, will succeed General Webb is said to have no definite foundation.

Professor Lachman, of the University of Oregon, has been invited to take charge of the chemical department at the University of California for the coming summer session.

Dr. Frank R. Van Horn has been appointed professor of geology and mineralogy at Case School of Applied Science, Cleveland, Ohio.

Dr. W. B. Huff, instructor in physics in the Johns Hopkins University, has been appointed associate in physics at Bryn Mawr College. Dr. Huff received his baccalaureate degree at the University of Wisconsin in 1889, his master's degree at the University of Chicago in 1896, and his doctorate at Johns Hopkins in 1900.

Dr. Fournier has been appointed professor of geology and mineralogy in the University of Besançon. Dr. v. Nathusius, docent in agriculture at Heidelberg, has been called to an assistant professorship at Jena. Dr. Wöhler has qualified as docent in inorganic chemistry in the Technical Institute at Charlottenburg and Dr. Brunner as docent in physical chemistry in the University of Lemberg.

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, MAY 16, 1902.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*METALLURGICAL LABORATORIES.**

To an old friend of the great captain whose munificence we celebrate to-day this privilege of adding a word of enthusiastic praise is most welcome. Let us congratulate Lafayette on this princely gift, and still more on the princely heart that prompted the princely gift. It is a pleasure to watch the growth and success of one whom we esteem; a very great pleasure to see the responsibility of that wealth which so often intoxicates where it should sober, so soberly and so wisely borne.

While the value of the metallurgical laboratory for purposes of investigation is evident, yet as instruments for teaching undergraduate students so few of these laboratories have been in long use, and their methods, aims and merits have been so little discussed, that not only the thoughtful part of the public, not only educators in general, but even a very large fraction of our metallurgical educators themselves, have but hazy notions about them. Indeed, there are many whose opinions cannot be ignored, many eminent metallurgical educators, who still doubt or even deny the value of the metallurgical laboratory for this purpose. Under these conditions it seems well that those of us

* An address delivered at the Dedication of the Gayley Laboratory of Chemistry and Metallurgy, Lafayette College, April 5, 1902.

who are confident that these laboratories are invaluable instruments should seize occasions like this to give the reasons for the faith that is in us, to the end that, if we are right, our allies, our sister schools here and abroad, may arm themselves with this potent weapon; and that, if we are wrong, we may discover our error through thus uncovering our reasons.

I ask your attention, then, to the use of these laboratories, not for purposes of investigation, for which their value is unquestioned, but for undergraduate instruction.

The objections urged against metallurgical laboratory instruction, so far as I understand them, are two:

First, metallurgy, like every other profession, has its art, and also its science, that is to say the systematic arrangement of the principles on which it is based. It is objected that professional education should be rather in the science than in the art, rather in the underlying and unchanging principles upon which the art reposes, than in the technique of the art itself. Principles, it is urged, are to be explained in words and thoughts, rather than in laboratory manipulations; they are to be imparted, then, by thought, by reasoning, by lectures and text-books, rather than by doing things with the fingers. The laboratory, it is urged, is no place to teach principles.

Second, the actual conditions of metallurgical practice on a commercial scale, that is to say the conditions of the art as it will have to be practiced, cannot be reproduced in any laboratory.

Let us examine these two objections.

The contention that education should be in principles rather than in the technique of practice, in the science rather than in the art, no educator worthy of the name can question. But this granted, the question remains how best to teach principles. To teach them effectively seems almost necessarily to require some conception of the things to which they relate; certainly, such conceptions must very greatly facilitate teaching. If the subject is of such a nature that sufficient conceptions concerning it have been formed during the student's prior life, then laboratory practice is less important or even superfluous; if not, if such conceptions are lacking or defective, then laboratory practice may be a most ready way of supplying or strengthening them.

Of the conditions attending metallurgy the student certainly has acquired no sufficient conceptions during his prior experience: his want here is more serious than in case of chemistry and physics; and because it is more serious, because these conceptions while hard to supply verbally, are readily supplied by laboratory practice, the metallurgical laboratory seems to me of the greatest value as a preparation to the study of the principles of this art.

Let us test this reasoning, this assertion that conceptions, if not a prerequisite, are at least an invaluable aid to the study of principles, of general laws. Surely, to grasp the principles of legislation there should be a conception of human nature; to understand the laws of music and painting there must be a conception of sound and color. Is not the same true then of chemistry and metallurgy, that in order to understand their laws the student should have a conception of the conditions and of the kinds of phenomena with which those laws deal?

The objection which at once arises is that, in case of mathematics no laboratory work is needed; that in case even of music and painting exercise in the art itself is certainly not necessary to enjoyment of its products, and probably not necessary to a clear comprehension of its principles. Why then in chemistry and metallurgy?

The answer is that the conceptions underlying mathematics, music and painting have already been acquired spontaneously, have become part of our very nature; and that in case congenital blindness or deafness has forcibly prevented the acquisition of the conceptions of color or sound, it has thereby made the study of the principles of painting or of music impossible.

Let us look at this a little more closely.

That every youth has acquired spontaneously and inevitably the conceptions underlying mathematics, the conceptions of number, distance, direction and force, seems clear.

The child deprived of every sense save touch begins with its first breath to familiarize itself with these conceptions. The resistance offered by fixed objects, the mobility of movable ones, the resistance which friction and inertia oppose to his moving them, the fact that he cannot move the bed post, that he can move his hand with ease, and his heaviest toy with difficulty, from the first give him the conception of force. The conception of two hands as distinguished from one is the conception of number, forced on him by every scene. Every glance of the eye, or if he is blind, every reaching out for toy or foot, gives the conceptions of distance and direction. These conceptions then are inevitable; they cannot be shut out by defects of the senses; hence the study of mathematics does not call for any special preparation comparable with the laboratory preparation for the study of chemistry and metallurgy.

So is it with music and painting to the child with all his senses.

The sighted youth comes to the study of painting with an eye trained from first infancy through sixteen hours of every day of most of his seventeen years, in color perceptions. They have been sunk into his very nature by the glories of the sunset, by the marvelous harmonies of the landscape, by the play of human expression, by the effects of shadow and perspective. He comes with conceptions so familiar and complete, so essential a part of his very being, that henceforth he cannot think shape without interjecting his conceptions of shade and color; he cannot conceive any object without conceiving it as colored or shaded.

To the study of the laws of music the youth with normal ear, the so-called ear for music, comes with the experience of seventeen years, those wax-like plastic years, of the sensuous pleasure due to certain sounds and sequences of sound, and the annoyance which others cause, not only to himself, but to those about him. The mother's lullaby begins his acquaintance with pleasurable sound; his own shrieks, the clanging bell, the squeaking slate pencil, early impress on him the disagreeable sound. So complete and familiar are his sound-conceptions that no special training in them is imperatively needed to enable him to begin the study of the science of music.

But let congenital blindness or deafness forcibly prevent him from acquiring these conceptions, and it thereby as forcibly and as absolutely unfits him for the study of the science of color or music. How can the congenitally blind, to whom red is but as the blare of the trumpet, comprehend a discourse on chiaroscuro? Or with what profit can you explain to them the proper tint of shadows while all conception of both tint and shadow is not simply vague, imperfect, rudimentary, but absent? Or how can the congenitally deaf understand the very terms harmony, discord, major and minor? Before they can conceive what minor means, must they not have some conception of sound?

Even after the missing sense has been given to one thus congenitally defective, to acquire the missing conceptions is a work of time. Open blind eyes at seventeen, and all is seen in confusion; time and acquaintance must make conceptions clear and familiar, conceptions and interpretations of shade and perspective, before the science of painting becomes comprehensible. Unstop deaf ears at seventeen, and not only is a symphony of Beethoven absolutely meaningless, but all sound fails to be interpreted. Only after time has supplied the familiarity with sound conceptions which childhood should have given, only then can the study of the principles of music be begun.

These cases thus support the contention that familiarity with conceptions and conditions, if not absolutely necessary to the study of principles, is at least an invaluable, an incalculable aid.

The student beginning the study of metallurgy has something in common with one who should begin the study of the science of music immediately after the instantaneous cure of congenital deafness. As it is hard for us to grasp our own infantile difficulties in interpreting the sensations on our retinas, so one who begins to teach metallurgy late enough in life to have lost sight of the mental condition of his student days is at first puzzled by the density of his pupils' ignorance. They lack the very beginning of those every-day conceptions so familiar to the teacher himself. To a man from the moon the conception that water runs down rather than up hill would be novel.

Without conceptions of metallurgical conditions and surroundings, your reasoning about metallurgical processes may wring an acquiescence from the student's intellect, but all remains unreal, unheld by the memory, unimpressed, like a pale algebraic demonstration.

Now I take it that the great object of laboratory instruction is to supply lacking conceptions. Though the youth has seen chemical actions going on around him, his attention has not been sufficiently concentrated on their essential features. The chemical laboratory reinforces his deficient observation, and clarifies his hazy conceptions of gasification, sublimation, precipitation, solution, fusion, liquefaction, solidification, freezing, diffusion, the exact balancing of reaction, substitution, the indestructibility of matter. Beyond this it impresses on his memory the chief characteristics of the more important chemical substances by vivid picture, and by personal acquaintance, instead of by mere description from the lips or pen of teacher. They become to him as his playmates in the flesh, instead of as the heroes of his story books. It is no just reproach to call this kindergarten work; calling names is poor argument. It does to the youth what the kindergarten does to the little child, directing observation into fruitful fields.

Why, now, have I said that the need of laboratory instruction is even more pressing in case of metallurgy than in that of chemistry or of physics? Because the conditions, especially the high temperature conditions, which surround metallurgy are stranger, less foreshadowed by childhood's prior experience, less readily evolved from our consciousness, less easily pictured by the words of lecture or textbook than those which attend chemistry and physics as these are chiefly taught, the chemistry and physics of the normal or every-day temperature, that little range between the freezing and boiling points of water. The conditions and phenomena even of common-temperature chemistry and physics indeed are relatively unfamiliar to the beginner; this however is not so much because they and their likes have not been seen, as because attention has not been concentrated upon them. The pictures are already in the memory, and respond readily to developing and fixing by skilful language. The daily ablutions teach the integration of soap and certain dirt, and the insolubility of other dirt; sugar and salt at the breakfast table teach solution; the settling of fine mud in the brooklet's pools teaches decantation; the clearness of the spring exemplifies filtration; the tea kettle and soda-water teach ebullition; the drying roofs show evaporation; the sweating of the ice pitcher illustrates the principle of the dew point; the sponge teaches surface tension. All these and a hundred like images already exist in the memory, and have but to be recalled to become vivid, but to be interpreted to serve as types of our chemical and physical phenomena.

But of metallurgical conditions the youth's past has given little foretaste. Especially is this true of the solvent fluxing action of that high temperature at which the rocks and most of the metals are as water, many other metals are gaseous, and strength and even solidity itself are to be found in only a very few substances. And even these react energetically on almost everything they can touch. In the crucible of the iron blast furnace there is but one substance which remains solid, which can offer support, and that is carbon; but this itself reacts on most things exposed to it, and is in turn attacked and destroyed by them. This reciprocal destruction, this Kilkenny-cat attitude of nearly every available substance toward every other, is not only itself unlike anything the student has previously known, but it results in a difficulty previously unthought of, the baffling difficulty of devising any retaining vessel whatsoever. The solids we children have known stay put; the liquids rest peacefully in the familiar tin can, or, in the few cases in which this may not be used, then in vessels of wood, glass, porcelain or clay indiscriminately.

Indeed, the fiery magmas with which metallurgy has to do, the molten metal, molten slag and molten matter, are in themselves and apart from their corrosive nature substances unlike anything in the notice of our early years, which has been directed chiefly to solids and aqueous liquids. The nearest approach to acquaintance with this class is the hazy conception of lava streams of which we have read. Still more remote from our experience are the reactions between these plutonic bodies which play so large a part in metallurgy, the purifying action of slag on metal, the slag's retentivity of metal or of metalloid, according to whether it is acid or basic; the coalescing of the oxides and acids into one magma, the slag; of the sulphides into a second, the matte; of unoxidized and unsulphuretted elements, both metals and metalloids, into a third magma, the metal; and the reciprocal expulsion which each magma exerts towards the other. Here indeed we have a class of bodies and of reactions so unlike those of which the usual chemical laboratory instruction treats, that metallurgical laboratory practice should be added to chemical.

To supply clear conceptions of these strange metallurgical conditions, and thus to build a foundation for thought and reasoning, is I believe the chief work, the invaluable work of the metallurgical laboratory.

To build this foundation well, the student should, I think, perform a great variety of simple experiments, each of which should direct his attention to a very few or even to one important principle, and avoid diverting it to attendant administrative details. For instance, his furnaces should in general be heated by gas or electric resistance, so that his attention may be concentrated on the phenomenon which he is studying, and not diverted to keeping a coal fire in proper condition. As far as possible these experiments should be quantitative.

If I am right in saying that the laboratory is thus an invaluable instrument for preparing the student for the study of principles, the first of the two objections urged against metallurgical laboratories, that education should be in principles rather than in practice, falls to the ground.

The second objection, that the conditions of actual practice cannot be reproduced in the laboratory would be unworthy of notice, were it not offered by men of such weight that even their errors must be considered.

The error lies in supposing that this instruction aims to anticipate practice in commercial establishments: whereas its aim is to facilitate instruction in metallurgical principles by lectures and text-books. There is no more reason for reproducing commercial practice exactly in the metallurgical laboratory than for reproducing in the chemical laboratory the system of kilns, towers and leaden chambers of the sulphuric acid works. But even from this mistaken point of view the objection is without weight. With equal force it can be urged that fire drill and military drill are useless, because they cannot reproduce exactly the actual conflagration, and the actual carnage and confusion of battle.

Another and important work of the metallurgical laboratory is to give a certain skill in the use of the instruments of precision of the art, in pyrometry, colorimetry and the microscopy of metals and alloys. It seems to me nearly as imperative that the metallurgist's diploma to-day should imply this skill as that the civil engineer's should imply skill in the use of the transit.

Finally, just as into a barrel full of potatoes a quarter of a barrel of sand can be poured, and then a quarter of a barrel of water, so after the student's power of study and note-taking in lectures has been thoroughly utilized, he still has power for much of this different, this observational and administrative laboratory work, in which he absorbs and assimilates priceless information like a sponge, and acquires along the path of least resistance and with but little mental effort the needed metallurgical conceptions.

HENRY M. HOWE.

A NEGLECTED FACTOR IN EVOLUTION.*

AN eminent Swedish zoologist, Dr. G. Adlerz, in a very suggestive paper† has recently called attention to some hitherto neglected conditions affecting the variability of organisms. Starting from the high degree of variability which has long been known to obtain in organisms in a state of domestication, Dr. Adlerz directs attention to the similar phenomena presented by wild animals during the great periodic increases in numbers brought about by unusually favorable trophic and meteorologic conditions.

In regard to the domestic organisms Dr. Adlerz gives expression to very generally accepted views when he says: "The changed conditions to which animals and plants are subjected in a state of domestication must, of course, mean a decided mitigation or even a complete cessation of the struggle for existence. They are provided with better and more abundant food than in the feral state and the survival of offspring is better insured. On the whole therefore the individual organisms are able to grow up under the most favorable circumstances.

"No matter how completely the germplasma may be shielded from external influences, it must, nevertheless, be susceptible to changes in the kind and amount of food, as Weismann admits, though he appears to lay little stress on this matter. If, as seems probable, variations are ultimately the resultants of physico-chemical processes in the germ-cells, it would seem to be very

* Contributions from the Zoological Laboratory of the University of Texas, No. 33.

† 'Periodische Massenvermehrung als Evolutionsfaktor,' *Biol. Centralbl.*, 22. Bd., No. 4, Feb. 15, 1902, pp. 108–119.

obvious that more abundant food must be responsible for the greater variability of domestic races. The organs, which in the feral state are continually exercised in a severe struggle for existence (in seeking food, pursuing prey, eluding enemies, in addition to other energy-consuming activities), do not under domestication compete so closely with one another for the less needed nutriment. Hence organs like the reproductive glands, which are not so directly implicated in self-preservation, are able to avail themselves of more food, and this should make possible, among other things, more numerous combinations of the varying elements. That greater abundance of food is thus one of the most potent, though indirectly effective, causes of variability in domestic races, may be regarded as an established fact, in so far as we are able to be certain of anything relating to this matter. It is a fact that the variability of these races in comparison with the conditions in a state of nature, has been enormously increased, and it would be difficult to point to any other factor in domestication of such decisive importance to the organism as surplus of food."

As Adlerz suggests in his paper, wild animals present certain peculiarities analogous to those exhibited by domesticated forms, viz., in the enormous numerical increase of periodic occurrence in many if not in all species. This increase must depend on conditions similar to those which produce a high rate of variability in domestic forms, *i. e.*, abundance of food and favorable meteorologic conditions. We should therefore expect to find a greater amplitude of variation as well as a greater number of individual variations during such increases than during periods of more limited increase. This is supported by the facts, as shown by Adlerz's observations on two such numerical increases in a butterfly (*Polyommatus virgaureæ*):

"These two increases in number were observed in the province Medelpad in central Sweden. The first occurred in 1896. That year the butterflies were seen to increase greatly during July till, by the middle of the month, they outnumbered all the remaining species of diurnal Lepidoptera. At the same time were observed a great number of a female variety not to be found in any other part of the country. This variety was distinguished by a series of light blue spots within the reddish-yellow band across the upper surface of the hind wings. The number and clearness of the spots varied greatly. The highest number was five, and from the varieties with the full number clearly developed, to the individuals of the dominant form, which had no spots at all, an uninterrupted series of transitional variations could be established.

"During the following year the species was not conspicuously abundant. Single individuals of the above described variety also appeared, but *they were both absolutely and relatively much rarer than among the increased number of the previous year.* Moreover, *no such marked variations were seen as on that occasion.* Hence the statement that *the amplitude of variation during 1896 was greater,* would appear to be admissible.

"During the past summer, 1901, the same species of butterfly reappeared in great numbers, and again, as in 1896, during the latter half of July the number of individuals was seen to exceed that of all the other diurnal Lepidoptera. And again the above-mentioned variety appeared in great numbers. By counting all the females among the numerous individuals that had settled on several large tansy patches, I found that many more than half showed the variation in question to a greater or less extent.

"These two numerical increases thus support the conclusion derived from theoretical considerations, that during the increase of a species both the absolute and relative number of varying individuals as well as the amplitude of variation are increased beyond what is usual."

The opponents of natural selection have often implied that conclusions drawn from domesticated animals cannot be used to explain the origin of varietal and specific forms among animals living under natural conditions. These authors seem tacitly to assume that the conditions of domestication are unique in that they can be realized only in human surroundings and under conscious human control. This, however, is not the case. The social Hymenoptera among insects, notably the ants, not only exhibit a form of domestication, as I shall endeavor to show, but also a pronounced and regular periodic increase in numbers. Thus they combine both the conditions for producing high variability, and furnish a brilliant illustration of the evolutionary factor to which Adlerz has called attention. Adlerz, who is well known as a myrmecologist, has, of course, utilized the ants to some extent in support of his views. He calls attention to the effects of feeding on the personnel of growing colonies. I believe it is possible in this connection to lay still greater stress on the facts. A considerable number of observations on colonies of different species of *Pheidole* have led me during the past three years to essentially the same views as Adlerz. As these ants beautifully illustrate the union of domestication and numerical increase and a concomitant high degree of variability, it seems best to record some of my observations and reflections in the hope that they may be of interest to those who are undertaking studies in variation.

It is now a well-established fact that every ant-colony is founded by a single fertilized female, or queen. The insect loses her wings and buries herself in a small cavity in the soil or wood that is to form the future nest. After entering the cavity she usually closes the opening so that she is completely shut off from the outside world. She deposits, at the expiration of a certain time, a number of eggs, and when these hatch as larvæ she does not go abroad in quest of food but feeds her offspring with substances regurgitated from her own body. These substances are ultimately derived from the fat body, a store of nutriment accumulated during her life in the maternal nest which she forsook to take the nuptial flight. Of course, the insect must derive her own nourishment from the same internal source and, as in all ants, the development of the young extends over a considerable period of time, it follows that the larvæ are of necessity poorly fed and after pupation hatched as dwarf workers (microërgates). The number, too, of these diminutive creatures is limited, so that the whole colony in this incipient stage is a family consisting only of the huge mother and a few dwarf offspring. These workers, though very timid, forthwith break through the walls of the chamber and establish relations with the outside world, whence they bring food into the nest and feed their half-starved parent. This food soon enables her to lay another batch of eggs, the larvæ from which are now turned over to the care of the workers. Being better fed, the second litter are able to reach a greater size before pupation and therefore give rise to larger workers than their nurses. The number of workers thus reinforced soon brings about a condition of affluence in the colony. The queen is more and more abundantly fed, and this, coupled with her confined and sedentary life, enhances her fecundity. The colony waxes strong in numbers and the workers of successive batches grow larger till they attain to the full stature of the species. Then, and not till then, do the ants begin to educate the fertile sexes, the males and queens. Enormous numbers of these, in some species hundreds or even thousands, are produced during the most favorable season of the year, and all these individuals are carefully fed, groomed and guarded by the workers till fully mature and ready for the hymeneal flight.

If we look upon the ant-colony as a complex of more or less heterogeneous individuals, comparable to the Metazoan body, which is also a complex of units, the more or less differentiated cells, we may say that the sexual individuals of the ant-colony develop only under favorable trophic conditions, just as the sexual organs of the Metazoan mature only under similar conditions. While this analogy is useful it is also advantageous for present purposes to look at the sexual forms of ants under a somewhat different aspect, viz., as organisms that are educated to maturity in what is essentially a state of domestication. This is obvious when we consider that the males and queens are not only reared from the eggs, but fed, groomed and guarded by the attendant workers throughout their whole imaginal life in the nest. All these attentions vividly recall the attentions lavished by man on the animals of his household. One is especially reminded of this resemblance on seeing the behavior of the workers towards the sexual forms, just before the latter are ready to take the nuptial flight. The males and queens are permitted on successive days to take the air about the entrance of the nest. At such times they are herded by the workers like so many cattle, and hastily dragged or driven into the nest on the slightest suspicion of danger.* The fostering instinct which, in the ant colony, envelops both the mature forms and the young of all descriptions, constitutes the basis from which myrmecophily and the various forms of symbiosis in general have been developed. The extraordinary development of this fostering instinct is demonstrated by the interesting fact that no less than 1,500 species of Arthropoda are now known to live with the different species of ants on terms of amity or toleration.

The sexual individuals, when finally liberated from the nest, are thrown entirely on their own resources, and for a time the struggle for existence sets in with great severity. One has an opportunity of actually witnessing both catastrophic and personal elimination often on a magnificent scale. The struggle among the males for the possession of the females is intense. The lives even of the fortunate among the former are rapidly extinguished. The surviving, fecundated queens set to work to establish their colonies, an arduous and complicated undertaking which ruthlessly eliminates all the poorly equipped. Even before they can dig their nests hundreds of these insects are devoured by birds, lizards, spiders, etc. And many more of them die from exhaustion while digging their nests, or from hunger while raising their first litter of young, or from the attacks of subterranean predatory insects, parasitic fungi, etc. This struggle, however, terminates on the appearance of the first workers, and the successful queens thenceforth again lapse into a condition of domestication till the close of their often very long lives. These general statements concerning the formation and growth of the colony will apply to most if not to all ants.* They

* I have seen beautiful instances of this in the Texan agricultural ant (*Pogonomyrmex barbatus* Smith var. *molifaciens* Buckley) and in our northern species of *Lasius*.

* In a former paper ('The Habits of *Ponera* and *Stigmatomema*,' *Biol. Bull.*, Vol. II., No. 2, Nov., 1900, p. 68) I maintained that the Ponerinæ perhaps constitute an exception to the general method of establishing colonies, but I have recently found in a small cavity in a stone a fertile deälated queen of *Odontomachus clarus*

will also hold good to a considerable extent of the social wasps and probably also of the termites. The colonies of the former, however, are of annual instead of perennial growth like those of ants and termites. This is a difference of no little importance from the standpoint of our discussion, since it is readily seen that the conditions prevailing among ants and termites must tend to develop and strengthen the domesticating instinct to an extraordinary extent. This is indicated by the host of known myrmecophiles and termitophiles as contrasted with the few guests and parasites known to live in the nests of wasps.

The dependence of variability on the age and trophic status of the colony is most clearly seen in ants that have polymorphic workers. The huge, cosmopolitan genus *Pheidole, e. g.,* is particularly interesting in this respect. Its species are characterized by having workers of at least two very different aspects: minute, small-headed workers proper, and huge-headed soldiers, often of monstrous aspect. In a few American species (*P. instabilis* Emery, *carbonaria* Pergande and *vaslitii* Pergande) these two forms are connected in the same nest by perfect series of intermediates. In the vast majority of species, however, such transitions are very rare or altogether wanting. The queens of *Pheidole* are much, the males but little, larger than the soldiers.

The soldiers are put to different uses by different species. In the grain-storing species they function as the official seed-crushers of the community. The diminutive workers collect the seeds and store and move them about in the chambers of the nest. They are, however, quite unable to break the hard shells, which yield only to the powerful jaws of the soldiers. In the carnivorous species the workers bring in pieces of insects, while the soldiers act as trenchers and sever the hard, chitinous joints. In the above-mentioned American species with polymorphic workers, I believe that the transitional forms may also be of use to the colony as seed-crushers and trenchers, since the vegetable and animal food is of different degrees of hardness and the work of making it accessible is not thrown on a single caste as it is in the strictly dimorphic forms. In some species the soldiers undoubtedly deserve their name, for they run about with wide-open mandibles and attack any intruder with great fury. In other species they are very timid and make for the concealed chambers as soon as the nest is disturbed. They thus manifest an instinct which is highly developed in the sexual forms, especially the queens, whom the soldiers also resemble in certain morphological characters more closely than they do the workers.

Under ordinary conditions only the workers of *Pheidole* go abroad, while the soldiers remain at home and very rarely stray beyond the entrance of the nest unless the whole colony is moving to a new home.*

surrounded by five diminutive workers. While it is certainly remarkable that one does not find similar incipient colonies of our other Ponerinæ, this observation makes it probable nevertheless that the ants of this subfamily agree with the Componotinæ, Myrmicinæ and Dolichoderinæ in their method of founding colonies. Concerning the methods employed by the driver ants (Dorylii) and ants of visitation (Ecitonii) nothing is known. These remarkable insects are so secretive in all that relates to their household affairs that only time and lucky observation will be able to fill this gap in our knowledge.

* The *Pheidole* soldiers may leave the nest when needed as trenchers to carve the carcass of some insect that is too unwieldy to be dragged home by the workers. I have observed this in two of our smaller species, *Ph. vinelandica* Forel and *Ph. splendidula* n. sp. (allied to *Ph. metallescens* Emery). In the former case a caterpillar had fallen into a large ant-lion pit about three yards from the nest and had evidently been killed and partially consumed by the ant-lion. The carcass was covered with workers and soldiers busily engaged in cutting it into portable fragments. In

They are fed, groomed and guarded by the numerous workers of the colony and may therefore be said to live in a condition of domestication like the queens and males.

During the past three years I have had many opportunities to examine *Pheidole* colonies in different stages of growth, and my observations bear out the following general conclusions which agree with those advanced by Adlerz:

1. Both the morphological and color variations increase both absolutely and relatively in number as well as in amplitude with the increase in the number of individuals in the colony.

2. This increase in variability is also in direct proportion to the increase in the trophic status of the colony.

The truth of these statements will be apparent from a consideration of a few cases. The first offspring of the mother queen of a *Pheidole* colony consist of a few very diminutive workers only. The second batch of young, at least in one nest of *Ph. dentata* which I examined, were, with a single exception, also workers, though larger than those found in the earliest stage of colony formation. This single exception was a soldier, with a much smaller head than that of the typical soldiers of this species, and its coloration was that of the workers. In more advanced nests the typical soldiers make their appearance, at first a few, then more, till they are abundant in old and well-established colonies. But they never become as numerous as the workers, since the latter are being continually reared in considerable numbers during the whole life of the colony. It is easy to observe, without resorting to statistics, that the number and range in the color variations in both the soldiers and the workers keep increasing, and in polymorphic forms, like *Ph. instabilis,* the heads of the soldiers show a remarkable progressive enlargement and increased complication in the details of coloration and sculpture. I have repeatedly found incipient nests of this species containing only workers and the small-headed soldiers of different sizes, so that I was at first deceived as to the species of *Pheidole* I had before me. One nest, examined during the current year, contained only a single soldier of the extreme, large-headed type so characteristic of the species. Such soldiers appear in considerable numbers only in very large, *i. e.,* old nests, and it is only in such nests that one finds, during late May, the highest efflorescence of the colony, the hosts of males and winged females. The soldiers of the extreme type in *Ph. instabilis* assume a monstrous, one might almost say hypertelic, appearance, the head being so large in proportion to the body that it may lead to serious results to the insect. I observed that when one of these soldiers happened to fall on the back of its head in one of my glass nests, it was often quite unable to right itself, but stood on its head wriggling its tiny body and legs for hours till it could clutch at a passing soldier and thus regain its normal position.*

It is an interesting fact that the workers

another pit-fall in the same locality two large ants (*Camponotus sansabeanus*) were being treated in the same manner by the soldiers and workers of *Ph. splendidula.* These observations are suggestive in connection with the problem of 'communication' among ants.

* This observation suggested some experiments with isolated soldiers. When these are dropped on their heads from a little height on a smooth surface, like clean glass or polished wood, they are often quite unable to regain a footing. Many remain in this position for hours or even for two or three days, struggling at brief intervals and finally dying of hunger or fatigue. If a bottle, the inner surface of which is moistened with a drop of chloroform or alcohol, is placed over the insect, it is at first stimulated to the utmost exertion to right itself, but it often dies of suffocation without being able to turn over.

and soldiers of *Pheidole* species often vary independently of each other, in both form and coloration and it has long been known that this variation is not a correlative one, since the examination of many species has shown that it is impossible from a study of the soldier of a given species to predict the form, sculpture and coloration of the corresponding worker and *vice versa*. This is beautifully illustrated, so far as coloration is concerned, by the Texan varieties of *Ph. hyatti* Emery. In west Texas (San Angelo, Terlingua, etc.) both soldiers and workers are of a rich fulvous yellow. In central Texas, however, the workers are black or nearly so, whereas the soldiers may be yellow throughout, brown with pale yellow heads, or in other nests nearly or quite as dark as the workers. Not only do the variations among the soldiers become numerous and considerable only in older nests, but the same is also true of the workers. In large nests of an undescribed seed-storing species (allied to *Ph. pilifera* Roger), I recently found several workers (macroërgates) of the size and coloration of the soldiers, but without any tendency to increase in the size of the head or assumption of the sculpture of the soldiers.

Among the males and virgin queens, which do not make their appearance till the colony is mature—in some species of ants not till the second or third year after the colony is founded—we also find very pronounced variations. These are, of course, more significant, since they occur in individuals undoubtedly capable of reproduction. Here we must include the whole range of normal and pathological variations, such as the various transitional forms between the workers and queens (microgynes, pseudogynes, ergatoids, macroërgates) and the pathological transitions between males and queens or between males and workers (hermaphrodites, or gynandromorphs) as well as the normal males and queens of different sizes, structure and coloration. *It is a significant fact that all these variations, no matter how aberrant, are cared for and protected in the nest so long as they are capable of being fed.* They are enveloped by the general fostering instinct which is so characteristic of the worker ants, since it leads to conditions in such marked contrast to the well-known goring instincts of cattle and the weaker but nevertheless perfectly patent analogues among men. The following facts show that the motives for a tragedy like the *Œdipus Tyrannus* do not exist in ant-society. In one of my artificial nests there is a congenitally crippled worker of *Polyergus bicolor* Wasmann that is scarcely able to walk. Still for the past three months it has been carefully fed and cleaned by the workers of the enslaved species (in this instance, workers of two species, *Formica subænesceus* Emery and *F. obscuripes* Forel). In the nest of a new species of *Leptothorax* I have seen a somewhat crippled lateral gynandromorph (male on the left side, with testis, worker on the right, with ovary!) that must have been fed and cared for by the workers as it was perfectly mature. Forel* describes a lateral gynandromorph of *Polyergus rufescens* that was moving in file with the normal workers and carrying a larva which it had pillaged. Here belong also the peculiar parasitized macroërgates which I described in a former paper.† These and many other cases that could be cited may perhaps make it easier to understand how monstrous neuter forms like the *Pheidole* soldiers could develop phylogenetically.

Several of the above mentioned variations, like the ergatoids and gynandromorphs, have not yet been observed in

* 'Fourmis de la Suisse,' p. 142.

† 'The Parasitic Origin of Macroergates Among Ants,' *Am. Natur.*, Vol. 35, 1901.

Pheidole species, but peculiar microgynes, or dwarf queens, certainly occur in some of the members of this genus. Emery* describes a dwarf deälated queen of *Ph. pilifera,* which was scarcely 3.5 mm. long. Normal queens of this species measure 6–6.5 mm. Emery's microgyne exhibited also an aberrant configuration of the epinotal spines. Recently Rev. P. J. Schmitt took two similar deälated microgynes in the nest of an undescribed *Pheidole* which occurs in Colorado and New Mexico. He kindly sent me one of these insects, which is smaller than any of the soldiers from the same nest. It measures only 2.5 mm., whereas a typical queen of the same species in my collection is 5 mm. long; and therefore eight times as large (in volume) as the microgyne. In this case the microgyne differs from the normal queen in color, pilosity and sculpture, so that had it been captured apart from the colony, it would certainly be regarded as the mother queen of a minute and very distinct species of *Pheidole.*

If it is true that the increasing variability exhibited by the *Pheidole* colony is the result of an increase in the number of its component individuals, and if this, in turn, may be traced to favorable trophic conditions, we should expect to find but little variation in colonies that are poorly fed and therefore unable to increase rapidly in number. This I find to be the case. In central and western Texas during the past autumn and winter the meteorologic and food conditions were extremely unfavorable, not only to ants, but to insects in general. Between September and the latter part of March almost no rain fell, and the protracted drought together with the cold of the winter months was very trying even to the ants that feed on stored seeds. During this period the number of soldiers in the *Pheidole* nests was found to be unusually small. In some nests of considerable size (*Ph. dentata*) they were entirely absent. One might suppose that the soldiers had died off on account of the unfavorable conditions, but this is improbable, because the vitality and hence also the longevity of the soldiers is superior to that of the workers, just as the vitality of the queens is much superior to that of all the neuter forms and the males.* I am therefore of the opinion that the scarcity of soldiers in the *Pheidole* nests was due to their not having been reared by the workers on account of insufficient food, moisture and warmth. Thus there was a tendency to suppress even the normal dimorphic variation of the neuter phase.

A peculiar Texan *Pheidole* (*Ph. lamia* Wheeler) may also be adduced as evidence of the inhibitory effects of unfavorable conditions on variability. *Ph. lamia* is a very small, timid species which lives a subterranean life under stones and feeds on dead insects, myriopods and crustaceans somewhat after the manner of the diminutive 'thief-ants' (*Solenopsis molesta* Say and *S. texana* Emery). It has the pale yellow coloration so characteristic of hypogæic species. Its very small colonies contain barely fifty individuals, and though I have found some eight or nine nests of this rare species in different localities and

* 'Beiträge zur Kenntniss der nordamerikanischen Ameisenfauna,' *Zool. Jahrb.*, Abth. f. Syst., 1894, p. 290.

* This is easily proved by observations on artificial nests that have not been supplied with the requisite food and moisture. In a nest of *Myrmica brevinodis* Emery which on September 14, 1901, contained forty virgin queens and five times as many workers, thirty of the queens but only two workers were still living March 14, 1902. *Myrmica brevinodis* lives in cool New England bogs, and it was difficult to maintain the right amount of moisture in the nest at all times during six months of very dry Texas weather. In this connection see also Lubbock's notes on longevity in ants ('Ants, Bees and Wasps,' pp. 41, 42).

have been able to capture the entire colonies, I have found in each case only a single soldier. This individual is of extraordinary aspect, its huge, cylindrical head being unlike that of any known species of *Pheidole*. In none of the nests have I been able to find a queen. As the abdomen of the single soldier is relatively larger than in other species of the genus, it is possible that this singular individual may produce eggs and thus replace the winged queen as the mother of the colony. The colonies of *Ph. lamia* certainly present a miserable appearance when compared with the teeming colonies of other species, and it is difficult to avoid the conclusion that the small size of the colony, the suppression of all but a single soldier and the possible elimination of the queens, are the result of unfavorable conditions. This ant is, I believe, really an effete or evanescent species, a species in what Hyatt called the phylogerontic stage.

Although many additional observations both of species of *Pheidole* and of other genera could be given, I believe that enough evidence has been presented to show that ants normally live under conditions eminently favorable to the production of variations and the preservation of these in the sexual forms till the latter are able to meet the exigencies of the struggle for existence with the best endowment of vigor and nutrition. We should therefore expect the ants to display a high degree of variability, and this is fully borne out by a study of these insects as a family in the taxonomic sense. Up to the present time the ants alone of all invertebrate animals have been successfully treated in taxonomy like the birds and mammals. The trinomial and quadrinomial nomenclature in the hands of Professors Emery and Forel admirably expresses the fine shades and relative stability of the form and color variations which can be recognized in these insects. It is safe to predict that a quinquenomial system may be necessary before long adequately to symbolize the still more delicate subvarietal deviations observed in different nests of the same varieties.

The importance of this high variability or plasticity from the standpoint of the development of instincts and intelligence, and in fact in all those life-activities which may be conveniently designated as *ethological*,* must be apparent on a moment's reflection. In my opinion the manifold and often wonderfully perfect morphological and psychological adaptations, which have made the ants the dominant group among terrestrial invertebrates, have their origin in the variability so greatly enhanced by the production of enormous numbers of individuals and the care and protection afforded, through a most important period of their lives, to the reproductive individuals of the colony. This is true no matter what views we may hold on the subject of selection since, so far as the substance of this paper is concerned, it may be immaterial whether we demand that there shall be many simultaneous variations of the same kind, that the variations shall be saltatory, gradual, determinate or indeterminate, whether we pin our faith to 'orthogenesis' or to Darwinism in its original form, to coincident ('organic') or to germinal variation. Any or all of these forms of variation may exist in the fully developed ant colony and, in all probability, also during the great periodic increase in numbers exhibited by many other animals.

William Morton Wheeler.

University of Texas,
March 19, 1902.

* In a forthcoming paper I hope to justify the use of this term as it is employed by some French zoologists in the place of the less satisfactory 'ecology,' 'natural history' and 'Biologie' in the German sense.

SOME SUGGESTIONS FOR THE IMPROVEMENT OF INSTRUCTION IN TECHNICAL CHEMISTRY.*

IN attempting to discuss so broad a subject as the methods of teaching technical chemistry employed in this country, one is met at the outset by numerous difficulties of interpretation. No two of the thirty-odd institutions claiming to prepare students for the practice of technical chemistry seem to agree on the topics necessary for study, the order in which these should be taken up, the extent to which any one should be cultivated, or the actual subject-matter of courses given under the same name; to say nothing of the non-chemical subjects in the curriculum, such as mathematics, literature, analytic mechanics and other 'strains and stresses.' In some colleges, chemical engineering seems to mean a mixture of less chemistry and less engineering than is required of either chemists or engineers; whereas in others 'analytical chemists' are turned out after one or two years' experience on 'unknowns and complex ores.' It is plain therefore that in order to arrive at any comprehensive view of actual and of desirable conditions, it will be necessary to define, in a manner somewhat more precise than is usually customary, the fundamental aims of technical education with reference to chemistry.

THE UNITY OF CHEMICAL PRACTICE.

Stated in its baldest terms, the aim of such technical education must necessarily be adequate preparation for professional practice. To be sure, this definition merely restates the problem itself; we must immediately ask, what do we mean by adequate preparation, and what by professional practice? Let us consider the latter question first. At first sight, the professional practice of the chemist appears as an exceedingly complex affair, incapable of closer statement; a chemist may be a mineral analyst, a food analyst, a metallurgist, a manufacturer of heavy or of fine chemicals, a gas-chemist, an electro-chemist, a pharmaceutical chemist, a dyer, a manufacturer of coal-tar products, a fermentation chemist, to leave out further subdivisions, and last but not least, a teacher of chemistry, perhaps the most technical of all. It will be said that this is far too broad a picture of the chemist's activity, and that the whole of technical practice may be summed up under three distinct heads: Analysis, manufacture, instruction. Indeed, it may be safely said that this represents the opinion of the majority of American and English chemists. And yet, the analyst, the manufacturer, the teacher are merely chemists, thinking by the same mental processes, applying the same general laws, attacking very similar problems, differing only in the accidental circumstances of the materials they work with. The analyst sacrifices time and money to the cause of accuracy; the manufacturer gives up accuracy for the sake of time and money; the teacher wears himself out in the effort to be accurate without wasting either time or money.

The fundamental unity of chemical practice is not a new discovery. It was 'made in Germany' some forty years ago; and although not patented, the Germans enjoy an exclusive monopoly of its use. The analyst, the manufacturer and the teacher are continually exchanging their experiences through a sort of chemical clearing-house. Young docents frequently spend two or three years in a factory for the purpose of broadening their knowledge; a factory sends its problems to the university

* Read at the Denver meeting of the American Chemical Society, August, 1901. This paper was written before the publication of Dr. McMurtrie's recent address to the American Chemical Society. It is gratifying to note the substantial agreement of both articles as to the problem set before our teachers.

laboratory to be solved. An investigator in need of expensive substances, or of mechanical appliances to handle large bulks of materials, need only apply to the nearest factory to have its machinery placed at his disposal, or its wares furnished at little or no cost. The largest factories have their own research laboratories, in which a hundred and more university graduates and professors spend months and years on single investigations, and are paid liberal salaries even if their results are technically worthless. One factory recently purchased the entire scientific library of Kekulé. The manufacture of nearly all the numerous coal-tar products consists merely of laboratory methods on a large scale; and the scientific problems solved in this connection have been of the utmost importance and benefit to 'pure' science. Certain large establishments prefer their chemists to have had training in pure science only, and then give them from three to six months of technical training in their own works *and at their own expense*. The specifications of chemical patents constitute an important section of scientific literature, and the German Chemical Society spends large sums of money for the purpose of abstracting and indexing them. If we also take into consideration the unquestioned preeminence of Germany in all branches of chemical practice, what better demonstration can we give of the fundamental unity of the profession?

PRESENT STATUS OF INSTRUCTION.

We are now in a better position to return to the former question: What do we mean by 'adequate preparation'? For no matter what may ultimately be agreed upon, it will be identical in its first two or three years for all classes of students. It is a great comfort to have this important point definitely settled in advance; for one of the main difficulties in arranging our college curricula has been the supposed necessity of providing two or more coordinate sets of courses in chemical instruction. This has been a great strain on the teaching staff as well as upon the financial resources of the laboratory.

An examination of a number of college catalogues brings out the fact that at present all students actually do follow essentially the same course for about two years. These courses usually consist of one or two terms of general inorganic chemistry and simple laboratory work, one or two terms of qualitative, one or two terms of quantitative, analysis; all these combined so as to occupy from two to three years at the rate of eight to fifteen hours per week. It would seem, then, that here we have the present American conception of 'adequate preparation'; for the subsequent courses are almost invariably special short ones in various branches of work. We may well ask: Is this preparation really adequate? I think not; but before considering it in detail as the main business of this paper, a few words must be said concerning these special addenda, the 'finishing courses.'

Even in some of our best institutions these final courses come perilously near the standard of the 'polite deportment' and 'philosophy' of young ladies' seminaries. There is an unfortunate lack of caution in the claims published in their catalogues. Lack of space prevents citation of many of the choice extracts I have found; two or three will suffice, however, for purposes of illustration. One college offers a course of *forty-four* lectures on the following topics: 'metallurgy, glass, ceramics, chemicals, illuminating gas, bleaching, photography, petroleum, brewing, wines and liquors, vinegar, fats and oils, essential oils and rosins, sugar, starch, glucose, milk, distillation of wood, paper tanning, etc.' One suspects that these lectures must be illustrated with a kinetoscope. Another institution claims to prepare its students for 'metallurgy and mining, chemical manufactures, dyeing, bleaching, tanning, sugar-refining, etc., and for work as analytical chemists, assayers, or teachers of chemistry.' The claim is based upon *three lectures per week* for two years, and two laboratory courses of twelve hours per week each, *which may be taken in one year.* A third college offers a course of *three hours per week for one semester* in 'qualitative and quantitative examination of air, water, food disinfectants, baking powders, flour, bread, tea, coffee, cocoa, spices, milk, butter, lard, beer *and other subjects.'*

It may be objected to the above that college catalogues are notoriously optimistic. The fact would seem to be demonstrated; none the less, such exaggeration is of very questionable value, and should be discouraged for the benefit of the 'raw graduate,' if for no better reason. It would appear, moreover, that the majority of colleges consider training in analytical methods equivalent to complete technical training; nearly all of them give several courses in water analysis, analysis of fuels, iron and steel, etc. The importance of such analytical training is undoubtedly over-estimated; a student who must continually neglect the factors of time and cost in his work receives too one-sided a training. The same objection is to be raised to many of the so-called courses in 'technical work.' If they do not consider time and cost as the essential factors, they have no better claim to a 'technical' nature than the ordinary beginner's preparation of hydrogen or chlorine. But more of this later.

Let us now examine more closely the nature of that preliminary preparation which we have found to be so nearly uniform throughout the United States. In the way of lectures, there is always a course on inorganic chemistry, occasionally a short one on organic, infrequently a very brief treatment of 'general' or theoretical chemistry incorporated with the above or as a separate course. Modern theories and the details of organic chemistry are usually left for advanced and optional courses. The time spent on these lectures varies greatly; but perhaps a fair estimate is three hours per week for two years (of about thirty-five weeks each). In many, in fact in most, colleges this average is not maintained. The laboratory training includes one, very infrequently two, terms of general introductory work, ranging from three to six hours each week. On the whole, this course may be described as satisfactory. Then follows a course in qualitative analysis, averaging twelve hours per week for one or two terms. Recitations accompany it in many instances, mainly for drill in writing equations, it would seem. In a few of the better institutions, but only in very few, the subject is made to serve as a practical demonstration of the theory of solutions. Finally, from one to three terms are spent in quantitative analysis, also averaging perhaps twelve hours a week. The subject-matter of this last course also varies greatly with the college; at the best, there is included training on a few alloys, sulphide ores, silicates, and a number of volumetric methods on technical products. The feeling cannot be repressed that in this course results call for a disproportionate expenditure of time. It is with the training afforded by the above that the student proceeds to follow his natural bent, and to acquire the special technical skill needed for his professional activity.

OUTLINES OF THE PROPOSED IMPROVEMENTS.

The technical preparations of the teacher need not concern us further. Every college and university is practically a technical school for training teachers first of all, and for training technologists only secondarily. Not that the training of teachers of chemistry is incapable of great improvement; but on the whole it is so much more satisfactory, that the improvement of instruction in other technical branches is more imperative. Moreover, taking as our major premise the essential unity of chemical practice, be it that of analyst, manufacturer or teacher, it follows that the main deficiency in the present training of our teachers is exactly the lack of knowledge we are deploring, and endeavoring to remedy. Should it be possible therefore to generate within the college walls the mental atmosphere of the busy world where *things* must be mastered as well as ideas, we shall also have ministered to the wants of the budding preceptor.

Having thus wearied you by a circuitous return to our starting point, in order to eliminate possible objections based upon differences in the point of view, let us again take up the question. 'What do we mean by adequate preparation?' If, in the following discussion, the proposals I have to make shall appear a trifle too radical, I trust you will bear in mind that they spring from a conscious and deliberate idealism; and should the views here expressed really prove to have a basis of truth, any merely practical difficulties will yield as surely as the difficulties of manufacturing indigo yielded to the idealism of the German professor.

I take it then that an adequate preparation for the technical chemist has been secured when (1) a sufficiently broad general foundation of inorganic, organic and physical chemistry has been laid in the class room and in the laboratory; (2) when the 'chemical instinct,' *i. e.*, the ability to think in chemical terms, has been developed; (3) when sufficient analytical skill has been attained to ensure accuracy in following new methods; (4) when enough preparative skill has been acquired to make any compound with maximum purity in maximum yield, at the lowest possible expense under given conditions; (5) when speaking acquaintance with current chemical thought, both pure and applied, has been reached; and (6) when time has been found to accomplish all this.

THE BROAD FOUNDATION OF CHEMICAL KNOWLEDGE.

First, then, as to the general foundation of inorganic, organic and physical chemistry, in the lecture room and laboratory. I think there can be no serious objection to the statement that the present equipment of our students in this line is too meager. The plan seems to be to give very elementary courses in all three subjects, and then to assume that this information will multiply by cell division in the laboratory atmosphere. Another very prevalent view among teachers is that if you only give the student fundamental ideas, the facts will take care of themselves. My own experience is that for the amount of time spent in study, the outfit of actual information about chemical substances is unreasonably small. The unfortunate policy of feeding students only on peptonized and malted facts may avoid mental indigestion in college, but it predisposes them to colic afterwards. Certain very prominent text-books have had a bad influence in this direction, by seeking to eliminate all possible difficulties of comprehension and any reference to partially solved problems. It is not uncommon for students to ask if they 'have to remember the names of those substances' in their lessons, after a few weeks with those books; indeed, the question is not unreasonable, if we consider that the names constitute the sole remaining difficulty. Again, both text-books and teachers seem afraid that the students will know too much, and prune out all except matter of the first importance. To be sure, excess of detail must also be avoided if clearness of presentation is sought; but is not the present tendency somewhat too violent a reaction from the methods of our forefathers? One very prominent teacher told me some years ago that each year he takes up less material in his lecture courses; what will become of them in ten years more? It is the function of the teacher to guide his students *through* the maze of facts as through a crowded city, that later they may find their own way about; not to whisk them around in a closed trolley-car, on the globe-trotter principle.

One difficulty lies in the use of text-books which are really only elaborated outlines of a lecture course. The result of using such books is that the student's horizon is bounded by the cover-boards. A lecture must be straightforward and consistent, if it is to have any value at all; but the printed page can be read over and over again, and its details mastered gradually. The text-book alone can provide the large number of facts that must be assimilated; the lecturer's syllabus is properly a key to the text-book, and no more. The teacher thus has a perfect right to demand of his students a greater knowledge of detail than he himself presents in his lectures. Another obstacle to the absorption of the proper number of facts lies in the almost universal attempt to treat a subject once and for all. This does not seem rational; nor do the student's mental limitations make it feasible. To take up the metaphor of the crowded city, the first efforts of a good guide result in a general survey, pointing out the topography, main thoroughfares and most important activities. Then come historical landmarks, and those sights which distinguish this city from all others; finally a detailed study of each quarter, of special industries and of prominent people. We can follow no better plan in teaching a new science, giving a broad survey first, then repeat, filling in many new details, finally going over it a third and fourth time, if necessary. In this way the student's memory will be aided rather than over-tasked; the relationship of parts to the whole, one of the most difficult of problems to him, will certainly be clearer; and the relative importance of various topics will stand out prominently. Then we shall avoid the necessity of turning out 'chemists' whose sole acquaintance with chemistry as distinguished from analysis was formed in the freshman year, and discontinued immediately thereafter. Chemical facts ought to be systematically studied each year of the college course.

But little need be said in addition to the above concerning the laboratory work to be correlated with this plan. I should merely wish to emphasize that substances should be studied from the preparative, analytical and physico-chemical sides simultaneously; the artificial division of the science for purposes of classification should influence the course of instruction little, if at all, during the first two years.

THE CHEMICAL INSTINCT.

Chemistry is a science which reasons about facts through a medium of abstractions. We observe colors, smells and precipitates, and we talk about atoms, molecules and space configurations. The thinking chemist must continually bridge the gulf that lies between fact and fancy; if he can do this freely, and avoid metaphysics, he possesses the chemical instinct. To develop this instinct in the student is the most important, and most difficult, problem of the teacher. Aside from intuitive, inherent teaching power, I know of but one plan for fostering this instinct: every topic should be presented in the form of a problem. Chemistry has advanced to its present proportions because of the problems presented to it; all research work is a series of correlated problems; the installation of every manufacturing plant, of every new process, the regular operation of every established factory, is a series of problems; every analysis for whatsoever purpose is a problem; teaching is one vast problem. The main preliminary to the solution of any problem is a clear and complete realization of its nature. What is aimed at, what are the difficulties, what means are available? These questions should be as definitely in the mind of the student at every point of his college work as they must necessarily be in his later professional activity.

ANALYTICAL SKILL.

Perhaps no portion of chemical instruction is better given than training in analytical work. Methods have been worked out with such precision, and mechanical aids are so perfect, that given time, patience and care, anybody may become a fairly skilled analyst. Moreover, teachers seem agreed that introductory work both in qualitative and in quantitative analysis should precede all special analytical courses. Perhaps it may seem superfluous to offer any suggestions for the improvement of this portion of chemical training; I shall discuss this later. At this point I wish to speak of these special courses. It has already been shown that they constitute the crux of the 'technical' training of this country. It seems to me that they tend to destroy the unity of analytical practice by inducing the student to specialize far too narrowly and far too soon. Students often spend the whole of their third and fourth years at college on these courses alone, and thus deliberately sacrifice the sole opportunity of their lives to acquire a broad and thorough training for all future emergencies. I have known students at one of the largest universities of the land to avoid all courses on theoretical and organic chemistry, on the ground that they would have no use for them at a blast-furnace—that college sending most of its graduates into the iron industry. Surely no college should thus encourage its students to neglect their opportunities. A little of the wise and far-sighted cooperation practiced by German employers would furnish immediate relief from this state of affairs. Experience has shown that the employer does not suffer by choosing broadly-trained chemists in place of stall-fed analysts.

Besides, most of the 'technical methods of analysis' taught in our colleges have a way of getting antiquated. Each year witnesses some new committee of technical societies for the purpose of improving analytical methods. By the time these methods get into the text-books (copper plates being valuable), another committee is under way. If such analytical instruction is reserved until the last term at college, and then based upon the reports of these committees, the student will be more likely to acquire really useful knowledge, and have more time for broader study.

PREPARATIVE SKILL.

Until quite recently the only training in the preparation of chemical substances was afforded by organic chemistry; latterly, a number of colleges have introduced courses in inorganic preparations as well. These courses constitute excellent discipline, as far as they go; they do not go far enough. The actual preparation of chemical substances may serve three purposes. It may be intended to place the substance in the student's hands for study; if no more is sought, it is often cheaper and always quicker to furnish it out of laboratory stock. It may be intended to illustrate the reaction. In combination with the first purpose this end is eminently desirable for beginners; for advanced students it wastes too much time in proportion to the result—such illustrations would be met as well by the use of chalk and blackboard. And finally, it may be intended as a study of chemical technology. As such it must inevitably take cognizance of the aims of technology, which are to prepare a substance in given grade of purity from the *available* 'Ausgangsmaterialien' at the smallest cost of time and money. It involves a sufficiently complete knowledge of the materials employed, strictest economy of time, labor and reagents, the demonstration of the required purity, and a calculation of cost and value. If a substance be prepared along these lines, to the amount of one gram or of one ton, it constitutes an exact duplicate of technical methods. The factory may employ cast-iron vats in place of flasks, and filter presses in place of funnels; it is not the more 'technical' by virtue of its appliances.

It will be objected that no university can make soda-ash or sulphuric acid on technical lines. To be sure; but it need not attempt to. The first condition of success in any undertaking is a clear understanding of one's limitations. The college cannot do much more than teach the factory spirit; if it does that much well, enough will be accomplished at present. Moreover, chemical industry is not limited to the production of heavy chemicals at the rate of fifty tons a day. Innumerable substances are manufactured in relatively small quantities, and by methods which do not differ widely from standard laboratory manipulations. These are wholly within the power of the college. I would propose that each college inaugurate as a part of its curriculum, required of all its graduates in chemistry, a full year's course in the actual economical preparation of laboratory supplies. It can manufacture most of its own C. P. reagents, ammonia and its salts, the products of the rarer minerals, ether much more cheaply than it can be bought or imported under existing revenue laws, and practically all its organic preparations, from a few technical products. Even if it should cost a little more to make these substances than to buy them, the gain in actual experience to instructor as well as to students is worth the extra cost. The equipment for this work need not be expensive. For the C. P. reagents, for example, the same outfit of large evaporators and crystallizing dishes, solution tanks and filter-presses can be used. The need of great care in cleaning these out for use on different materials would be an excellent feature of the work, to be controlled by analysis. By systematic planning, the laboratory could manufacture from thirty to sixty substances a year, in quantities to last five years; at the end of that period it would have supplied all its wants and could begin the cycle over again. In one year of such work the student would gather more experience than a factory would yield in ten; for no factory can undertake to slow down its procedure for the benefit of a novice.

In connection with this laboratory instruction, the usual lectures on chemical technology will certainly be more fruitful of results. Such lectures should not be omitted, nor anything else likely to broaden the student's acquaintance with facts. Indeed, these lectures are able to supply information not obtainable in the factory, viz., the *comparison* of factory methods, and the deeper principles that underlie all technical work and are taken for granted—the business world drives them home with a club. Finally, it need hardly be said that *frequent* visits to every establishment within reach should be a constant feature of technological training. In my own college course the 'frequent visits' materialized just *once*, when three large factories were visited in the course of two hours—another illustration of the optimism of college catalogues.

ACQUAINTANCE WITH CURRENT CHEMICAL THOUGHT.

The necessity of familiarizing students with new facts at first hand is self-evident, and realized by all conscientious teachers. The main difficulty would appear to be the accomplishment of the task. I know of only one method—to weary not of well-doing, and to keep everlastingly at it. Frequent meetings of students and instructors on an informal basis, be it a seminar or a 'chemical society,' where new facts are discussed without reference to their classification, comprehensive lectures on recent progress, essays by the students themselves, the current numbers of journals laid out in a cozy reading room *in the laboratory* (the librarian must be overcome by fair means or foul)—all of these methods persisted in for two or three years will solve many a 'complex unknown' cerebral obstruction. *Ad astra per aspera.*

WHERE TO FIND THE TIME.

The ambitious program I have outlined now calls for the consideration of a purely practical problem: How can we find the time to accomplish all this? Even as our courses stand, there is barely time within the four years at college to complete the minimum of chemical work; where is there room for all the extra lectures and laboratory exercises that a really thorough technical preparation would seem to call for? I am afraid that my suggestions will contain many heresies.

For one thing, our college authorities must be made to realize that the main essential of training in technical chemistry is a knowledge of chemistry. This somewhat axiomatic doctrine is by no means universally accepted. Thus, the chemical engineers in two prominent institutions (Columbia and Pennsylvania) take considerably less chemistry than other students in chemical branches. Now while other topics are certainly necessary and valuable assets for chemical engineers, there must be a limit somewhere. The main problems before even the chemical engineer are chemical; those of the teacher and analyst almost wholly so. I will not presume to outline just how much or how little of these extraneous courses should be incorporated in the curriculum for technical chemists; but I should like to venture upon the principles which may fitly guide those more directly concerned with the task. I should say, then, that the question should be considered upon its own merits; no inherited prejudices, no educational theories, should stand in the way of the prime fact that in studying chemistry a knowledge of chemistry comes first. The problem of general education and culture must not be allowed to interfere in any way; where cultural education is also sought, the time needed for it must be debited to its own account, and not written off the technical calendar. The two problems are absolutely distinct, and have no business with each other. This must be insisted upon, since college faculties are only too prone to ignore it altogether. Better for a college not to give any technical courses at all, than to play at make-believe and ruin the careers of its graduates. If four years at college are not enough for both general and technical education, take six, eight or ten—but take enough to do the work thoroughly. I would say also that the non-chemical subjects should be reduced to the lowest possible figures, and chemistry be given the benefit of every doubt. Wherever feasible, these subjects should be a part of the general education, and thus serve both ends; such would be, *e. g.*, German and French, physics, first-year chemistry, mathematics, etc. The cardinal rule should always be kept in mind, that it is better to know one thing well than to have a smattering of many and command of none. We must not expect to see in each of our students a Helmholtz or a Ludwig Mond; if any of them are destined for such versatility, they will have little need of our poor instruction.

One solution of the time problem, then, is to insist that enough time must be granted, and all extraneous matter reduced to a minimum. By the same token, however, it behooves us as conscientious chemists to do our best to shorten the time required for our own subject—for the benefit of the student, it might be observed, not for the benefit of the college faculty. By the aid of one further heresy, I feel able to indicate where an important saving of valuable time may be accomplished. I would abolish from the curriculum the study of qualitative analysis, the arch-type of anachronisms. We owe a tender feeling to the kindly nurse who brought us up carefully, and taught us the dark ways and vain tricks of the phosphates; but our nurse is old and decrepit, and no longer able to guide the toddling steps of the beginner. It will not be difficult to prove this. The study of qualitative analysis is intended to give knowledge of a useful art, and specific exercise in chemical thinking. It achieves neither purpose.

SYSTEMATIC QUALITATIVE ANALYSIS AS A USELESS ART.

The problem of systematic qualitative analysis as taught in our schools is to recognize all the ingredients of a given mixture. As a matter of fact, however, how much of this art have we achieved? We are able to recognize a limited number of inorganic acids and bases under special circumstances; and the instructor must exercise great self-restraint not to make his unknowns 'too hard.' As for the rarer acids and earths, to say nothing of the vast bulk of organic compounds, as well as for the commoner acids and bases in the presence of these latter substances, we must admit our inability to follow any comprehensive 'scheme' of analysis. The analysis of such mixtures resolves itself into a series of special tests, and our only check upon the correctness of the analysis comes through the quantitative necessity of finding one hundred per cent. of the ingredients. This limitation is clearly recognized by the professional analyst. Thus the chemists of the U. S. Geological Survey never carry out qualitative analyses of the rocks they investigate; they assume that all of some twenty or thirty ions are or may be present, and check the absence of any one during the progress of the quantitative analysis. Nor do they undertake to analyze one single sample for all of these thirty ingredients; two or more possible ones constitute a group that is examined by itself, without reference to the other contents. Again, the analyst is seldom, if ever, called upon to make a complete analysis of an absolutely unknown brew; on the contrary, he is usually asked to estimate some two or three ingredients, whose presence is either known or whose absence is to be demonstrated. The assayer never makes other than a quantitative analysis of gold and silver ores. For the food analyst, all is grist that comes to his mill—moisture, fats, carbohydrates, proteids and ash.

Where then is our boasted art of qualitative analysis? And where the need of dragging every chemist through the wearisome unknowns, so fearfully and wonderfully made, the like of which man never saw before nor will again? Why spend from two hundred to four hundred valuable hours to teach an art which does not exist? At the same time, it will be objected, the numerous qualitative tests referred to must be learned, and as well this way as any other. Not so; the important qualitative reactions of all the important substances should be studied in the first instance, when the substances themselves are studied—not be kept on ice for a 'systematic' course. In the laboratory instruction in elementary chemistry time can be found for the methods of recognizing the acids and the metals the student works with, while he is working with them. We must counteract our mania for subdivisions and classifications, and teach chemistry as a unit. To be sure, the regular 'scheme' for the metals and acids is a useful thing *occasionally,* and students ought to be familiar with it; but it can be taught in one week to any student having a fair supply of analytical reactions among his mental baggage. I would teach these reactions by the side of a course in chemical preparations, rather than in a course by themselves.

QUALITATIVE ANALYSIS AS AN INFERIOR DISCIPLINE.

The intrinsic value of qualitative analysis is thus seen to be small. Its pedagogic merit is not much greater. As a matter of fact, teachers know only too well that it requires herculean exertions on their part to prevent students from rushing through the course mechanically. The majority of text-books are the merest skeletons of outlines, omitting a vast bulk of details 'because they interfere with a clear grasp of the subject.' One is strongly reminded of the way Latin is—or used to be—taught: the object being to reproduce its literature and culture, the literature and culture are left out to have more time for the syntax. So with qualitative analysis: the object being to train analysts, the analytical facts are left out to have more time for the system. Nor are we alone in our troubles; permit me to quote from the recent vice-presidential address of Professor W. H. Perkin to the British Association:*

* *British Association Reports,* 1900. Cf. Science, Vol. XII., p. 641, 1900.

"It has always seemed to me that the long course in qualitative analysis which is usually considered necessary, and which generally precedes the quantitative work, is not the most satisfactory training for a student. There can be no doubt that to many students qualitative analysis is little more than a mechanical exercise; the tables of separation are learnt by heart, and every substance is treated in precisely the same manner; such a course is surely not calculated to develop any original faculty which the student may possess. * * * I question whether any really competent teacher will be found to recommend this system as one of educational value or calculated to bring out and train the faculty of original thought in students."

With this quotation I am content to rest my case.

WHAT SHALL WE SUBSTITUTE FOR IT?

One important question remains. The art of testing unknown substances must always be an integral portion of the chemist's outfit; if the present course, designed for that very end, fails to teach it, what alternative have we to offer? The plan I venture to suggest may be found worth a trial.

I propose, first of all, to annul the divorce of chemical analysis and chemical preparation. Many colleges now introduce quantitative experiments into their *beginner's* course, such as (I quote in part from a circular issued by a conference of teachers at Chicago in 1896): definite proportions by volumetric methods, multiple proportions from the oxygen evolved from potassium chlorate and perchlorate, equivalent weight of zinc, weight of a liter of air, water of crystallization in copper sulphate (both stages), neutralization of normal acids and bases, etc. If along with these quantitative experiments the student is also taught the descriptive features and qualitative tests of the substances studied, as well as the fundamental facts of physical chemistry (also recommended and elaborated by the Chicago conference), I should say that there we had a course eminently satisfactory. If time permits, a year might be spent with great profit on this work. Then should come a course of the same general order, but more difficult. Starting with a metal, a mineral or some technical product, the student should prepare a series of salts or other compounds of some ten or more metals. He should study the problem of obtaining the desired compounds; submit his plans to the instructor for criticism; prepare his substances, and analyze them qualitatively and quantitatively. The analyses should not be complete, but merely for effective purity and undesirable impurity; for *economy of labor should be taught,* and no work done that is not of direct value under the given circumstances. By a proper selection of material, the teacher will be able to present to his pupils, during two or three terms, all of the important qualitative and quantitative methods of separation. Nor is it necessary for each student to do exactly the same work; indeed, I should call it undesirable. Students would then learn from each other as well as from the teacher, and a laboratory 'atmosphere' would then be created where students may learn by a process of cutaneous absorption —as they seem to do in Germany. The work, moreover, should be reported regularly in the accompanying seminar; current and older periodical literature should be searched for additional information bearing on each student's topics; innumerable little opportunities for research will present themselves, and the most ought to be made of them; a well-planned course of lectures should parallel the laboratory work and expand its horizon, for the whole field of chemistry cannot be reviewed in the laboratory; and then, I venture to believe, the instructor will have a class of interested, if not enthusiastic, students. Special schemes of separation, the 'systematic' analysis now so widely current, the examination of milk and honey, can then be taught as the special things they are, and made to take their proper places in the economy of chemistry.

CONCLUSION.

In conclusion, allow me to summarize the propositions I have tried to maintain:

1. The practicing chemist, be he teacher, analyst or manufacturer, is of one kin.

2. For that reason, the training for these professions ought to be identical for *several* years, at least.

3. At present this training is inadequate.

4. There is needed a much broader foundation in pure chemistry.

5. The 'chemical instinct' needs cultivation.

6. Analytical training should be general rather than special.

7. The college should establish *bona-fide* courses in preparations, on a working scale.

8. Acquaintance with current thought must be fostered.

9. Time must be made for this program by cutting off all but the most important non-chemical topics.

10. Time can also be saved by eliminating qualitative analysis, because it is useless as an art and inefficient as a discipline.

11. The place of qualitative analysis should be taken by properly organized laboratory courses.

Perhaps it will be best to leave the twelfth and last conclusion to the charity of my hearers.

ARTHUR LACHMAN.
UNIVERSITY OF OREGON.

SCIENTIFIC BOOKS.

A Laboratory Manual of Botany. Outlines and Directions for Laboratory and Field Work in Botany in Secondary Schools. By Otis W. Caldwell, Ph.D. New York, D. Appleton & Company. 1902. Pp. ix + 107.

This little book has for its chief characteristic a serious though perhaps not wholly successful attempt to give organization and direction to elementary work in plant ecology. Certainly the author deserves credit for making the attempt, for ecology will not be on a sure footing in secondary education until it becomes organized, and until the problems which are set have a definite character, and are commensurate with the mental ability of secondary students. As a general criticism pertinent to this remark we would be inclined to say that some of the work indicated is not above the abilities of students in the earlier grades, notably work in seed distribution and the like; while other parts of it are beyond the opportunities, certainly, if not the general intelligence of secondary students. At least, this is the feeling that the reviewer has in regard to the study of the ecology of plant societies.

The work is divided into two parts, consisting of sixty-two and forty-five pages, respectively, the first dealing with plants at work, the second with the structures of plants as they have developed in relation to the problems of nutrition and reproduction. Examining the second part at once, we do not notice that it deviates notably from the treatment of plants in the 'type course' as outlined in a good many text-books. We feel that the author has not indicated sufficiently clearly a definite line of thought, nor has he made, in some instances, the best choice of material. This appears notably in the treatment of the Hepaticæ, among which, as every botanist knows, we may find as interesting and instructive a series of types bearing on the general features of the evolution of the plant body, as may be found in the whole plant series. The study of such material may, we believe, very profitably be substituted for that suggested, viz., that of *Marchantia,* a by no means satisfactory type for the group when standing alone, on account of its very high degree of specialization.

Turning to the first part, we may consider it as a guide to laboratory and field work made necessary by a previously published work, Coulter's 'Plant Relations,' and it has, among others, the merit in particular that it puts the material and problems in, for the most part, fairly definite form. The reviewer cannot admit to have been won over as yet to belief in a course in ecology as an elementary course for the secondary school. He therefore sees much more to criticize than is, perhaps, wholly justified except upon general grounds. Such criticism applies therefore chiefly to the subject matter rather than to the book before him. For example, one is almost oppressed by the amount of knowledge which a student must be assumed to have in order to explain ecological problems placed before him. The work becomes, then, merely observational, or a mass of unanswerable questions. If the former, better in the elementary school; if the latter, better that it should be a subsidiary part of the course rather than the backbone, so to speak. Again, it would seem that the results which accrue from a lesson do not always justify the amount of material used.

The author that sets before himself the task of indicating problems in question form has not chosen the easiest one. Good questions are good things—among the best means to stimulate and guide the thought of the student. In this particular Dr. Caldwell has done well. The questions are, for the chief part, within the range of the student, and direct the mind from one observation to another in a satisfactory manner. The form of the question is sometimes unfortunate, pedagogically considered. 'Could,' introducing a question, involves deduction unnecessarily, that is, where the inductive method is the only sure one for the beginner at least.

The outlines will have, too, a stimulating effect upon field work, which should thereby be enhanced in value. This, by the way, is a feature of merit in the second part, in which field study is suggested and outlined, as for example in connection with the Algæ.

An introductory chapter containing some

suggestions for the equipment of the laboratory, and the use of the microscope, with, at the end of the volume, reference lists of dealers and materials, complete the volume, and increase its usefulness for secondary teachers and students, to whom it is on the whole by no means ill adapted. FRANCIS E. LLOYD.

The Cyclopedia of American Horticulture. By L. H. BAILEY and WILHELM MILLER. Comprising suggestions for cultivation of horticultural plants, descriptions of the species of fruits, vegetables, flowers and ornamental plants sold in the United States and Canada, together with geographical and biographical sketches. Vol. IV., R–Z. New York, The Macmillan Company. 1902. Pp. xxx+1487–2016; pl. 31–50; ff. 2060–2800.

Professor Bailey is to be congratulated on the completion of a work that will long stand as one of the monuments of horticultural progress, useful alike to the gardener, the student of cultivated plants and the seeker after general information relating to such plants.

The task he set himself was a hard one, for unless arbitrarily limited the field is a large one, the details intergrading and of unequal importance, and almost every step is beset with nomenclatorial and other pitfalls, between which a safe course is all but impossible because so many of the difficulties admit of only subjective solution which, when opinions differ, cannot please every one. With the good judgment but positive action for which he is noted, he has handled elaborate questions conservatively and as consistently as could be expected, considering that the several articles have been written by many persons whose opinions could hardly be reduced to a uniform level on any matter of policy.

The more notable parts of the concluding volume are the editor's preface, including a history of the planning and execution of the work and an outline for proposed supplements, and the articles on railroad-gardening, *Rhododendron, Ribes, Rosa* and rose, *Rubus, Salvia, Saxifraga, Scilla, Sedum,* seedage, *Selaginella, Sempervivum,* shrubbery, *Sorbus, Spiræa,* spraying, storage, strawberry, *Syringa,* tomato, transplanting, trees, *Tulipa, Ulmus, Vaccinium,* vegetable gardening, *Verbena, Viburnum,* village improvement, vines, *Viola* and violet, *Vitis,* walnut, wild garden, winter protection, and *Zea.* W. T.

The Science of Penology: The Defence of Society against Crime. By HENRY M. BOIES. New York and London; G. P. Putnam's Sons. 1901. Pp. 459.

The author of this book approaches his subject from the practical rather than from the scientific side, as is indicated at the outset by the fact that he is a member of the Board of Public Charities and of the Committee of Lunacy of the State of Pennsylvania. He makes no pretentious claims to originality; he wishes simply to 'collate and systematize' what others have done with a view to awaken a wider interest in the rational treatment of criminals and to assist those who make and execute the laws against crime. The really interesting and significant point about the book is that in a work which thus 'aims at practice' and is written by a practical man, the standpoint of those who during the last quarter of a century have sought—amid the ridicule of practical men—to put criminology on a scientific basis, is definitely accepted, and accepted almost as a matter of course. It is sufficient to mention the headings of the three sections into which the book is divided: Diagnostics, Therapeutics and Hygienics. In other words, from a book to which is attached the old-fashioned label of 'penology,' the subject of punishment is simply omitted altogether. At one point, it is true, the author would appear to admit the idea of punishment in so far as it may be of therapeutic value, but on the whole he has nothing whatever to say to it. "Criminal codes as they exist are," he states, "in the light of twentieth century intelligence, a conglomeration of penalties of various degrees of atrocity, irrationality, absurdity and inutility. They are the relics of blind social struggles against social evils, useful chiefly as antiquities, to be collected with thumb-screws, iron boots, racks, and torture wheels in museums. To provide an efficient substitute for these codes, to enunciate the principles upon which a successful defence of society against crime must be conducted and the abolition of criminality accomplished, is the special province and object of penology. * * * The supreme object of penology is to prevent crime, not to punish for it. It is similar to the science of medicine and surgery in that its province is not only to cure specific cases of disease, but also to prevent the genesis, recurrence and spread of disease." In this very radical statement, and in his assertion that 'criminality is a preventable and curable disease,' Mr. Boies goes further than most scientific criminologists are prepared to go. His absorption in his own subject also leads the author at times to regard the elimination of criminality as the main end for which the state exists, and to advocate unhesitatingly strenuous measures of somewhat dubious character, such as forbidding the marriage of various classes of criminals and even castrating them.

It must be said that the general tone of the book is distinctly dogmatic, and the author seldom appears willing to admit that any question can have two sides to it. He makes few references to authorities, and it may be gathered that his estimates as to the comparative values of authorities are somewhat uncritical. At the same time Mr. Boies has written a distinctly useful book. He may be described as a disciple of Ferri, adopting the same broad sociological standpoint as the eminent Italian author and making an attempt to adapt Ferri's principles to American conditions. It may be added that the book has been admirably produced by the publisher, and shows a praiseworthy absence of inaccuracies and misprints.

Havelock Ellis.

SCIENTIFIC JOURNALS AND ARTICLES.

The *Botanical Gazette* for April contains a continuation of Professor Frederick C. Newcombe's paper upon 'The Rheotropism of Roots.' It will be completed in the May number, when the principal results will be noted. Mr. John Donnell Smith publishes his 23d paper under the general title 'Undescribed Plants from Guatemala and other Central American Republics,' including descriptions of about twenty new species, and also of a new genus (*Donnellia*) of the Commelinaceæ, by C. B. Clarke. Accompanying the paper are two double page plates by C. E. Faxon. Miss Alice Eastwood concludes her 'Descriptive List of Plants collected by Dr. F. E. Blaisdell, at Nome City, Alaska,' describing new species of *Mertensia, Pedicularis, Pinguicula,* and *Aster*. Mr. E. B. Copeland discusses Haberlandt's 'New Organ of *Conocephalus*,' which he has called a substitute hydathode. Mr. Copeland shows that there is nothing very surprising or remarkable in the behavior of these structures, and that they are essentially similar to such as the same condition produces in many plants, the conditions being excess of moisture.

The American Naturalist for April begins with an article by Henry F. Osborn on 'Homoplasy as a Law of Latent or Potential Homology,' homoplasy being the independent similar development of homologous organs or regions giving rise to similar new parts. Applying this is to the teeth Professor Osborn finds that similar cusps have been developed in unrelated mammals in different parts of the world, and that there is some underlying principle which determines in a measure the course of evolution. Ales Hrdlicka presents some 'New Instances of Complete Division of the Malar Bone, with Notes on Incomplete Division,' and Herbert P. Johnson describes 'Collateral Budding in Annelids of the Genus *Trypanosyllis*.' This method is considered as an advance over linear budding and the genus as representing the most highly specialized mode of asexual reproduction among annelids. J. B. Johnston and Sarah W. Johnson discuss 'The Course of the Blood Flow in *Lumbricus*' in some detail, stating that their experiments give no support to the idea that there is a more or less complete segmental circulation in the genus. The notes and brief reviews are numerous.

The American Museum Journal for April contains an account, with illustrations, of an exhibit of birds' bills, feet, tails, wings and feathers, designed to illustrate terms used in ornithology, as well as to call attention to the connection between the form and function of these parts. A course of lectures on the birds of spring is announced. The Supplement is a 'guide leaflet' to the collection of baskets from the graves of the ancient Indians of southeastern Utah, which comprises the oldest known baskets from this continent.

The Popular Science Monthly for May opens with a discussion of 'The Electronic Theory of Electricity' by J. A. Fleming, while a review of the 'Sulfuric Acid and Its Manufacture by Contact-process' is given by R. Kneitsch. Carl H. Eigenmann considers 'The Physical Basis of Heredity,' concluding that the chromatic threads are the carriers of hereditary power; the article is very clearly written and enlivened with touches of humor here and there. 'Children's Vocabularies' are discussed by M. C. and H. Gale, who show that these are, even for very young children, much more extensive than is generally imagined, and that they largely depend on what the children wish. Havelock Ellis presents an article on 'Mescal: A Study of a Divine Plant,' giving in detail the results of some experiments, and deciding against it as a therapeutic agent. 'Infectious Diseases' and their possible cure is by Alfred Springer and 'The Relations of Electrically charged Molecules to Physiological Action' by Jacques Loeb, while A. S. Packard describes 'An Afternoon at Chelles and the Earliest Evidences of Human Industry in France.'

Harper's Magazine for May contains an article on 'Marine Fish Destroyers' which fairly teems with erroneous statements and misleading deductions. It is only necessary to cite Dinosaurs one hundred feet in length, with a height of thirty feet and a thigh bone eight feet high, Mosasaurs seventy-five feet in length, and Zeuglodonts with limbs unknown, to show the exaggerated style of statement. The largest Dinosaur actually measured falls inside of seventy-five feet, and the largest femur found is six feet eight inches long, and but a single one of this size has ever come to light. Few Mosasaurs reached a length of forty feet and the vast majority are under twenty-five, while the limbs of Zeuglodon are known. The misleading deductions are as to the amount of fish destroyed by these animals, the writer not taking into account the fact that it is by no means proved that all these extinct animals lived so extensively on fish as is stated, and that it is not at all probable that they required a hearty dinner every day, much less obtained one. Worst of all is the inference that since so many fishes perish from natural enemies it makes no difference how many man captures, nor does it do any good to pass laws for their protection. Aside from the universal decrease of anadromous fishes which are particularly open to the attacks of man we have the notable decrease of the whitefish and Lake Trout of the Great Lakes, the noticeable diminution in the size of mackerel brought to market and the fact that the halibut fishery is now prosecuted at depths and distances once undreamed of. It would hardly be necessary to notice this paper at length but for the fact that the position and titles of its writer give undue weight to its statements in the mind of the reader, while its publication in a popular magazine spreads it broadcast and causes it to be read by hundreds who will not know that there is quite another side to the subject.

SOCIETIES AND ACADEMIES.

A PACIFIC SECTION OF THE AMERICAN MATHEMATICAL SOCIETY.

The mathematicians of the Pacific Coast held a meeting in San Francisco on May 3 and formally organized the second Section of the American Mathematical Society, to be known as the Pacific Section. The following officers were elected: Professor Irving Stringham, *Chairman;* Professor G. A. Miller, *Secretary;* Professor R. E. Allardice, Dr. E. J. Wilczynski and the secretary, program committee. The following papers were presented during the two sessions of the Section:

'On a Linear Transformation, with some Geometrical applications': Professor R. E. ALLARDICE, Stanford University.

'A Movement whose Centrodes are Cubics': Dr. E. M. BLAKE, University of California.

'On the Determination of the Analytic form of the Distance between two Points by means of Distance Relations': Professor H. F. BLICHFELDT, Stanford University.

'A Canonical form of the Binary Sextic': Professor M. W. Haskell, University of California.

'Constructive Theory of the Unicursal Cubic by Synthetic Methods': Dr. D. N. Lehmer, University of California.

'Algebraic Relations among the Integrals and the Reducibility of Linear Differential Equations: Dr. Saul Epsteen, Göttingen. (By title.)

'The Limits of the Minima of Definite Ternary Forms': Dr. J. H. McDonald, University of California.

'A Short Method of Deriving Osculating Elements of the Major Planets': Professor A. O. Leuschner, University of California.

'On the Groups of Genus One': Mr. W. A. Manning, Stanford University.

'Determination of all the Groups of Order p^m, which include the Abelian Group of Order p^{m-1} and of type (1, 1, 1, ---)': Professor G. A. Miller, Stanford University.

'On the Non-Abelian Groups in which every Subgroup is Abelian': Dr. H. C. Moreno, Stanford University.

'Dynamic Effect of Stationary Waves on Immersed Bodies': Mr. P. G. Nutting, Göttingen. (By title.)

'Concerning Quadruple Systems': Dr. T. M. Putnam, University of California.

'A Synthesis of Orthogonal Substitutions': Professor Irving Stringham, University of California.

'Congruences Defined by Functions of two Complex Variables': Mr. A. W. Whitney, University of California.

'Geometry of the Covariants of a Binary System of Linear Homogeneous Differential Equations': Dr. E. J. Wilczynski, University of California.

According to the By-Laws adopted by the Section there will be two meetings per year—one in May and the other in December. These meetings are to be held in or near San Francisco. The first Section of the American Mathematical Society, known as the Chicago Section, was organized in 1897 and also holds two meetings per year. The Society holds four meeting per year at Columbia University in addition to a summer meeting, which has generally been held in connection with the meetings of the American Association for the Advancement of Science. G. A. Miller,

Secretary.

ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

The 328th meeting was held March 11. A presentation of casts of the Neanderthal, Spy and Engis skulls was made by President W. H. Holmes and Dr. Frank Baker.

Professor Holmes placed the geologic time scale on the blackboard and located on it the various finds of fossil human remains, explaining the conditions under which the finds were made and the difficulties attending even approximate accuracy in determining their position.

From the somatological point of view Dr. Baker discussed the criteria of the determination of skulls and applied these to the crania under discussion. Dr. Baker said that the Neanderthal and Spy skulls are certainly not pathological as has been affirmed by some writers. Mr. J. D. McGuire in discussing the paper held that the man of Spy was possessed of classes of artifacts belonging to a much later period than students had generally admitted.

Dr. A. E. Jenks read a paper entitled 'Some Steps in Amerindian Economics.' This paper defined economic man as one who produces for use and future gain and affirmed that the American Indian north of Mexico had arrived at economic emancipation. Dr. Jenks outlined the study of economics in this field, giving the ramifications growing out of production for future gain and the effects on the development of the American Indian. The paper was heard with great interest and provoked an extended discussion participated in by Dr. J. Walter Fewkes, J. D. McGuire, Professor W. H. Holmes and Walter Hough.

The 329th meeting was held March 25, and was devoted mainly to technologic subjects.

Mr. Emil Berliner gave an interesting talk on the history of instruments for recording and repeating sounds, tracing the inventions from the eighteenth century to the present. The earliest form of phonograph with tinfoil sheets on which records of speech were made and gramaphone of the most recent type were exhibited and contrasted.

Mr. Fred. M. Tryon read a paper dealing with the development in hydrotechnics tracing the historic and ethnographic range of the inventions applied to raising and distributing water and showing the tremendous strides made in the art at the present time.

Mr. P. B. Pierce's paper on wireless telegraphy presented in an attractive manner this most recent of the great inventions. Mr. Pierce pointed out the various steps by which wireless telegraphy came to be and called attention to the interaction of minds and inventions to produce new inventions. In conclusion Mr. Pierce explained the apparatus employed in wireless telegraphy.

The 330th meeting was held April 8.

Dr. Franz Boas of the American Museum of Natural History, New York, read a paper entitled 'Anthropological Organization in America.' The paper, which was prefaced with a review of the history of the existing societies, was devoted to a discussion of the question whether it is advisable to add a new organization to the number as has been lately proposed in the formation of an association of a national character, or to centralize and combine all such agencies in such manner as to strengthen the present and prospective organizations. Dr. Boas concluded that such work could be better done through Section H. of the American Association of the Advancement of Science, swarming from the parent hive as the Geological, Chemical and other Societies, from their respective Sections of some years ago.

In the discussion of Dr. Boas' paper, participated in by W J McGee, W. H. Holmes, Dr. George M. Kober, J. Walter Fewkes, and J. D. McGuire, there seemed to be a consensus of opinion that the new society should be of a national character, organized on broad lines, designed to promote the interests of anthropology in America. It was recognized that for convenience of meetings, etc., it might be advisable to maintain a connection with the American Association if such arrangement could be made.

A paper by Hon. A. R. Spofford followed, entitled 'Ceremonials, National, International and Social,' which was entertaining and instructive. Mr. Spofford rapidly sketched the wide range of ceremonial forms in time and their prevalence among uncultured peoples. The ultra forms of ceremonious politeness were held up to ridicule.

WALTER HOUGH.

DISCUSSION AND CORRESPONDENCE.

THE VOLCANIC ERUPTION IN MARTINIQUE AND POSSIBLY COMING BRILLIANT SKY GLOWS.

THE terrific volcanic eruption in Krakatoa, near Java, in 1883, was productive of such brilliant phenomena in the sky and air and added so materially to our knowledge of the motions of the atmosphere that meteorological observers would do well to watch for the earliest appearance of similar phenomena from the recent outbursts in the West Indies. Such observations may aid greatly in the study of the motions of the air.

Up to the date of the Krakatoa explosion, it had been supposed by meteorologists that the air forming the trade winds approached the equatorial belt from both sides and ascending near the equator turned toward the poles, becoming a southwest upper current in the northern hemisphere and a northwest upper current in the southern hemisphere, flowing over the trade winds below.

The observations on the Krakatoa phenomena gathered by the committee of the Royal Society and discussed by Russell and Archibald show that the upper currents in the tropics between 20°N. and 20°S. moved from the east with a velocity of about 75 miles an hour. This was indicated by the progress of the haze and sky glows which were traced around the world three times in succession. (See 'The Eruption of Krakatoa and Subsequent Phenomena,' London, 1888.) The very fact that the authors were able to follow the dust cloud and its attendant phenomena indicates that the upper air movement within this belt is very uniform in velocity and direction, otherwise the cloud of smoke and haze would have very quickly disintegrated and it would have been impossible to trace it even once around the world with a nearly parallel front as was done by Russell.

These observations were not in accord with theory and it was at first supposed they might be due to temporary movements of the atmosphere. But Abercromby was so much impressed by the phenomena that he began to gather observations of cirrus within the tropics (see *Nature*, 1887–1889). These observations were followed by the systematic work of Hildebrandsson who has shown that the prevailing motion of the cirrus between 20°N. and 20°S. is from the east. Above these latitudes the prevailing cirrus motion is from the west.

It is probable that between these two regions of opposing winds there is a narrow belt of comparative calm across which the air moves very slowly from the equator. The spread of the dust from Krakatoa across this region apparently did not exceed a velocity of one mile an hour, so that it was two months or more after the eruption before sky glows were observed in high northern latitudes.

It is evident that observations on the sky glows following volcanic eruptions are very desirable for the study of the atmosphere. It is thought that some bright sunsets observed at Blue Hill last autumn may have been connected with a volcanic eruption in May in Java and subsequent brilliant sunsets in Mauritius described by Claxton. If notes were made elsewhere of unusually brilliant sunsets we should be glad to receive them at this Observatory and also accounts of such sky phenomena as may follow the eruption at Martinique.

Henry Helm Clayton.

Blue Hill Observatory,
May 10, 1902.

THE WORD 'ECOLOGY.'

To The Editor of Science: After the full discussion of the origin, history and use of the word *ecology* in Science for April 11, it is certainly surprising to read the inexcusably erroneous statements about this word by Mr. F. A. Bather in the current number of the same journal. After correctly stating the meaning of the word, Mr. Bather goes on to say: "Haeckel and biologists generally have used the word in the above sense, but of recent years the botanists have wrested, or at least restricted, the meaning of the term to the study of the associations of plants in such groups as alpine, sand-dune and desert plants; and this is the sense intended on pp. 458, 459 of Science for March 21. In a word they have used 'œcology' instead of 'œcological plant geography.'" This statement is extremely misleading if not wholly erroneous. It is possible that some writers have so restricted the term, but I cannot recall any case of it. Mr. Bather cannot surely here refer to Cowles's use of the phrase 'physiographic ecology,' because Cowles, in his elaborate paper in which he introduces the phrase expressly defines ecology in its full scope and shows that his use of the term is by no means an attempt at a restriction of it. Botanists, universally as far as I know, use the word in very nearly if not exactly its original broad sense, as applying to all forms of adaptation of organisms to their environment, and hence it is perfectly proper to apply it to plant associations when studied from the point of view of adaptation. If it were needful I could cite columns of references to prove this usage, but I will simply refer to the fact that ecology is used in its broad sense, with no attempt at such restriction as Mr. Bather avers, in all the modern botanical text-books including Campbell's 'University Text-Book' just issued, in a recent official publication ('Report on a College Entrance Option in Botany') by the Society for Plant Morphology and Physiology, and in many recent special papers upon plant adaptations.

Quite inexcusable, further, is Mr. Bather's statement that Robert Smith, in his justly praised paper on the 'Study of Plant Associations' (in *Natural Science* for February, 1899) does not mention the word œcology. Smith uses it no less than four times in that paper. Thus on page 113, Smith says, "Reiter (1885) modified Grisebach's scheme of plant forms to reconcile it with later research in plant œcology." Again on page 112, Smith says, "In the bibliography at the end of this paper a few only of the chief of these have been mentioned as representative œcological works, dealing with such marked forms of vegetation as strand plants, aquatic plants, halophytes, desert plants, etc." And he uses œcological again in the footnote at bottom of page 115, and again, on page 110. Mr. Bather's implication that Smith did not use the word œcology in connection with plant associations is therefore without foundation. In fact Smith used the word precisely as other botanists are using it to-day.

Mr. Bather calls the form *ecology* a 'vagary of incorrect spelling' of *œcology*. The shorter spelling was formally recommended in 1893 by the foremost botanical organization in this country, on the general ground that the same considerations which make *economy* preferable to *œconomy* make *ecology* preferable to *œcology*. The recommendation has been followed by practically all writers on botanical subjects in this country and occurs in nearly all of the botanical works of the highest educational and scientific standing in America, (Campbell's recent text-book is the only exception I have noticed), and in most if not all papers now appearing based on original work upon adaptations. Whether under these circumstances the form ecology can be properly described as a vagary of incorrect spelling I leave the reader to judge.

W. F. GANONG.

TO THE EDITOR OF SCIENCE: In spite of the number of letters written with regard to the word ecology, the fact has been overlooked that the Standard Dictionary gives ecology, so spelled, with a cross reference to œcology, and so it is a great mistake to say that the newest spelling is not in the latest dictionary. It seems only just to the Standard Dictionary that this statement should be made.

WALLACE CRAIG.
HULL ZOOLOGICAL LABORATORY.

IN view of the recent discussion as to the tardy recognition of scientific terms by the dictionaries, it may be interesting to note that the word *tropism* which is now so commonly used in the discussion of the origins of motor reactions in organisms does not appear in any of the dictionaries (including the 'Century') that are accessible to me. Neither this term nor the term *ecology* belong to the class of narrow technical terms but would demand general definition on account of their comprehensive connotation. I am not aware of the origin or the exact degree of recentness of the term *tropism;* but my impression is that it has been used sufficiently long to have secured some recognition. Still it must be remembered that the word *appendicitis* was not current enough when the first volume of the 'Century Dictionary' appeared, to warrant its inclusion.

JOSEPH JASTROW.

INDIAN SUMMER.

TO THE EDITOR OF SCIENCE: I wish to call the attention of your readers to the exhaustive articles on the origin of the term Indian summer, which is published in the *Monthly Weather Review* for January and February of this year. Mr. Albert Matthews (145 Beacon Street, Boston, Mass.), the author of this memoir, has spared no labor in collecting the early examples of the use of this term. Its first recorded appearance is in the year 1794 in the journal of Major Ebenezer Denny for October 13, 1794, while at Le Boeuf, a few miles from the present city of Erie, Pa., and there can be no doubt but what the term was in extensive use and well recognized at that time. Since that date numerous explanations have been given by different persons as to the origin and original meaning of the term, but these are of the nature of myths or hypotheses and it is very much to be hoped that we shall yet discover earlier cases and the true history of its introduction. We shall be very glad to hear from any one who can add anything of value to the elaborate paper by Mr. Matthews.

CLEVELAND ABBE.
WEATHER BUREAU,
U. S. DEPARTMENT OF AGRICULTURE.

BOTANICAL NOTES.

NATURE STUDY.

WE have had all sorts of books on 'Nature Study,' and for the most part they have been an abomination with nothing to redeem them, possibly with the exception that the authors 'meant well.' Enthusiastic persons who knew nothing exactly about nature, and still less about children, wrote impossible lessons for the pupils in the schools, and too often the superintendents knowing no more in regard to either, 'adopted' these misbegotten productions, and issued instructions to teachers to dole out so many pages a week to the defense-less pupils in their charge. What botanist has not seen these books which are filled with gush and nonsense, and nothing more? A few days ago a new book on nature study appeared, and it did not require long examination to show that it is of an entirely different order. It was prepared by Professor Hodge of Clark University, and it is not too much to say that it is by far the best and *sanest* book on this subject that has yet appeared. The inevitable result of such work as the author outlines will be the greater love of nature by the child, and yet we do not find that pupils are urged and admonished to 'be good children, and love nature.' There is absolutely nothing of this kind, yet the book is eloquent in suggestions of the lovableness of plants, and birds, and insects, and all manner of creeping things. The namby-pambyism which the healthy-minded boy so properly hates and despises is wanting, and in place of it are the most suggestive of photographs, and descriptions of things that live, and are waiting to be seen by sharp-eyed children. The book must be seen to be known, but a few of the chapter headings will give some idea of the treatment. 'Children's Animals and Pets,' 'Insects of the Household,' 'Garden Studies, Home and School Gardens,' 'Propagation of Plants,' 'Common Frogs and Salamanders,' 'Our Common Birds,' 'Practical Domestication of our Wild Birds,' 'Elementary Forestry,' 'Flowerless Plants,' are some of the titles. The book will no doubt find its way into many schools, and it should drive out the swarm of worthless volumes that have preceded it.

OUR KNOWLEDGE OF THE FUNGI.

THE sixteenth volume of Saccardo's Sylloge Fungorum, which has just made its appearance enables us to judge of the rapidity with which mycologists are describing the species of fungi. The last preceding supplementary volume containing descriptions of added species, appeared in August, 1899, so that but little more than two and a half years have passed, and yet we have here an aggregation of 4,314 descriptions, and an appendix of 539 new species and varieties for which the descriptions are not generally given. These 4,853 additions to previously described species bring the total number in the work as a whole up to 52,157. If we make no allowance for synonyms and descriptions of 'forms' this is the total number of fungi now known. The additions in this volume are divided as follows: Hymenomyceteæ, 886; Gasteromyceteæ, 120; Uredinaceæ, 523; Ustilaginaceæ, 79; Phycomyceteæ, 55; Pyrenomyceteæ, 1,102; Laboulbeniaceæ, 231; Discomyceteæ, 466; Deuteromyceteæ ('Fungi Imperfecti'), 1,367. A general index to all of the volumes, I. to XVI., completes the volume.

PACIFIC SEASIDE BOTANY.

FOR the past ten years there has been maintained at Pacific Grove, two miles west of Monterey, California, a summer school of investigation, under the name of the Hopkins Seaside Laboratory, in which exceptional opportunities for botanical study have been afforded. The session this year opens June 9, and continues for six weeks and the botanical work is to be under the direction of Dr. A. A. Lawson. In addition to the usual general course in botany, there are courses for advanced students in the marine algæ, cytology, and microtechnique. The well-known richness of the marine flora of this part of the coast renders work in this laboratory especially instructive. There are two two-story buildings capable of accommodating eighty students, which are used for laboratories. As the Laboratory is a branch of the biological departments of Leland Stanford Junior University, the facilities are certain to be complete as to apparatus, libraries, etc.

A thousand miles north of Monterey is another seaside station, at Port Renfrew, Vancouver Island, under the charge of Professor MacMillan, of the University of Minnesota. It was established last year, and a successful session was held. This year the session opens about the middle of July and extends to the 1st of September, Botanical instruction will be given on the Phæophyceæ (MacMillan), Rhodophyceæ (Yendo), Chlorophyceæ and Cyanophyceæ (Tilden). The results of the first session lead us to look for work of a high order at this station. The brown seaweeds (Phæophyceæ) are represented by an unusally large number of species, and are very abundant. Certainly the Pacific Coast botanists are to be congratulated upon having two such excellent stations for study and research.

MULTIPLICATION OF SPECIES IN BOTANY.

IT is never safe to 'call a halt' in any department of science, much less in a department in which one is not himself a specialist; yet such non-specialist may be permitted to give his impressions as an interested on-looker from another part of the field. And as it often happens that the soldier in a different part of the field of battle is able to see more clearly what is taking place than those in the thick of the mêlée, so it may be that botanists just a little outside of the work of descriptive systematic botany are able to measure the real value of some of the work now being done. One can hardly take up a botanical journal without finding that some of the common species of plants have been split into two or more forms called 'species' by their authors. That such work must be done is inevitable, but it is incredible that ten to twenty species should have been able to hide themselves in plants which had been critically studied by such masters as Gray, Torrey and Watson. As long as these leaders were found to have confused only two or three species in one the interested on-looker was ready enough to accept the dictum of present-day specialists in single genera, and to admit that the masters had blundered, but when we are asked to believe that Gray and Torrey were totally blind and incapable of seeing or defining the limits of species, it is evident that these later workers are dealing with something of which their predecessors either knew nothing or cared nothing when they were defining species. In 1878 there were catalogued for North America in Watson's Bibliographical Index 14 species and 10 varieties of hawthorns, of the genus *Cratægus*. In 1899 these numbers had risen to 34 species and 11 varieties. To-day we are asked by several botanists to add to this list 225 new species almost entirely from the eastern United States, where three years ago there were not *one tenth as many!*

Of course this brings up the old question of the limits of species. This can not be discussed in a short note, but this is certain, that in the case cited we are asked to give greater values than formerly to observable variations. This is carried to such an extreme that one is compelled to ask whether this change is warranted. Are not these new species merely local variations, or in some instances individual variations? The ornithologists have noticed similar minute variations in birds, although they have not regarded them as specific, but rather varietal, or sub-varietal. Yet there are ornithologists who question the wisdom of requiring that all members of a particular sub-variety should have been taken 'under the same blackberry bush.' Are not the botanists who are making so many species open to a similar criticism? If in *Cratægus* we have species with such slight variations, what are we to do with the varieties of the common apple trees? We shudder at the thought of these species-multipliers getting into our orchards. There must be at least a thousand or so good 'species' hidden in *Pirus malus* of Linnæus!

CHARLES E. BESSEY.
THE UNIVERSITY OF NEBRASKA.

THE COLLECTED PHYSICAL PAPERS OF HENRY A. ROWLAND.

A VOLUME containing the physical papers of Professor Henry A. Rowland, for twenty-five years professor of physics in the Johns Hopkins University, is now in preparation. It will be issued under the editorial direction of a committee appointed for that purpose, consisting of President Remsen, Professor Welch and Professor Ames. The book will contain Professor Rowland's articles and memoirs on physical subjects, together with his popular writings and addresses, numbering sixty in all. These have been collected from over twenty different magazines and journals. The subjects treated in these papers cover a wide range. In heat there is the great memoir on the mechanical equivalent of heat, with several shorter articles on thermometers. In electricity and magnetism there are the fundamental researches on magnetization, on the magnetic effect of electrical convection, on the value of the ohm, on the theory and use of alternating currents, etc. In light there are the renowned discovery and theory of the concave grating and the long series of investigations made in the field of spectroscopy. List of wave-lengths will not be reprinted in this volume, as they are readily accessible elsewhere; and any subscriber to this volume may obtain by application to the Johns Hopkins Press, Baltimore, a copy of Rowland's 'Preliminary Table of Solar Wave-lengths.' There will be, further, a description of Rowland's ruling engine, used for the making of gratings, details of which have never before been published.

The Memorial Address of Professor Mendenhall; published in SCIENCE, and a portrait of Professor Rowland will also be included.

The volume will be printed in royal octavo, bound in cloth, and will contain between six and seven hundred pages. The price set is five dollars per copy for orders sent in advance of publication.

Orders may be sent to Professor Joseph S. Ames, Secretary of the Committee of Publication, Johns Hopkins University, Baltimore, Maryland.

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*THE INTERNATIONAL CATALOGUE OF SCIENTIFIC LITERATURE.**

THE Third International Conference on this subject, held in London during June, 1900, after considering the questions left in abeyance by the two previous Conferences, decided to publish an annual book catalogue arranged according to both an author and a subject index of the following named sciences: Mathematics, Mechanics, Physics, Chemistry, Astronomy, Meteorology (including Terrestrial Magnetism), Mineralogy (including Petrology and Crystallography), Geology, Geography (Mathematical and Physical), Paleontology, General Biology, Botany, Zoology, Human Anatomy, Physical Anthropology, Physiology (including Experimental Psychology, Pharmacology and Experimental Pathology), and Bacteriology.

Government aid was offered by many of the countries represented by delegates. The catalogue was to consist of an index to all original contributions to science published after January 1, 1901. Regional bureaus were to be established in the several countries charged with the duty of furnishing to the Central Bureau an index of the scientific literature of their respective countries. The price of the catalogue was fixed at $85 per annum for the 17 annual volumes, subscriptions to be made for a period of five years. At the present time the affairs of the catalogue are as follows: The United States Government having as yet failed to contribute toward the support of a regional bureau, the Smithsonian Institution has temporarily undertaken the work.

The equivalent of over 71 complete sets, representing over thirty thousand dollars, have been subscribed for in the United States.

In February the Central Bureau reported that over fifty-one thousand catalogue slips had been received from the Regional Bureaus.

The first parts of Chemistry and Botany will be published during the present month, to be shortly followed by parts of Physics and Physiology. It was found necessary to publish these first volumes in two parts. The next publications will be the complete volumes of Mathematics, Astronomy, Meteorology and Bacteriology for 1901. Single volumes may be subscribed for at their proportional value. A provision has been made for those desiring a card index to print some of the sets on one side of the leaf only in order that the separate entries may be mounted on cards. The charge for the volumes so printed will be about one sixteenth in addition to the cost of the regular form.

* Abstract from a paper on the International Catalogue of Scientific Literature read before the American Philosophical Society, April 4, 1902, by Cyrus Adler, Ph.D. (For fuller history see SCIENCE, August 6, 1897, June 2 and 9, 1899. Also reports of the First, Second and Third International Conferences, published by the Royal Society, of London.)

SCIENTIFIC NOTES AND NEWS.

THE degree of LL.D. was conferred on Lord Kelvin by Yale University on May 5, this being the first time for over a hundred years that the University has held a special assembly for the conferring of an honorary degree. Lord Kelvin was presented for the degree by Professor R. H. Chittenden, director of the

Sheffield Scientific School. President Hadley in conferring the degree said: "You have joined the different regions of the earth by your investigations of the submarine telegraph; you have joined the different realms of human thought by your contributions to physical theory." Lord Kelvin last week paid various visits, especially to the electrical laboratories of New York City, and sailed for England on May 10.

THE Bavarian Maximillian Order for Science and Art has been conferred on Professor J. H. van't Hoff, professor of general chemistry in the University of Berlin.

THE seventieth birthday of Professor von Leyden, the eminent pathologist, known especially for his work on diseases of the spinal cord and on tuberculosis, was celebrated at Berlin on April 20. In addition to the presentation of a *Festschrift* and other marks of esteem, a fund for research was established amounting to about $11,000.

DR. ALEXANDER AGASSIZ has been appointed director of the Museum of Comparative Zoology of Harvard University.

THE Geographical Society of Philadelphia has awarded to Lieutenant Robert E. Peary the Elisha Kent Kane medal. It was received by Mrs. Peary on her husband's behalf.

DR. ABRAHAM JACOBI, of Columbia University, has been elected as chairman of the American Committee of the Fourteenth International Medical Congress to be held at Madrid a year hence. Dr. Howard A. Kelly, of Johns Hopkins University, will deliver the address at one of the general meetings of the Congress, and has chosen for his subject 'The Passing of a Specialty.'

DR. J. L. WORTMAN, of the Peabody Museum of Yale University, will be in the West until September, exploring the fields in Dakota, Wyoming, and the Bad Lands, where the late Professor Marsh made his important paleontological discoveries.

ERNST A. BESSEY, in charge of the Section of Seed and Plant Introduction in the United States Department of Agriculture, has been detailed to proceed to Russia, the Caucasus, and Turkestan for the purpose of securing certain seeds of forage and cereal plants. He is to sail on July 2.

AN expedition to northern Brazil will be sent out by the Austrian Government in the autumn under the direction of Dr. M. Steindachner, curator in the Vienna Museum of Natural History.

A BRONZE tablet in memory of Professor James H. Coffin, the eminent meteorologist, for many years professor of mathematics at Lafayette College, has been presented to the College by the class of 1866.

WE regret to record the death of Henry Morton, the eminent engineer, president of Stevens Institute of Technology since its foundation in 1870. We hope to publish a notice of President Morton's life and work.

COLONEL MALCOLM WILLIAM ROGERS, who carried on important engineering work in India, died on April 25 at the age of sixty years.

M. HENRI FILHOL, professor of paleontology at the Jardin des Plantes, Paris, and the author of numerous important contributions to this science, has died at the age of sixty years.

IMMANUEL LAZARUS FUCHS, since 1884 professor of mathematics in the University of Berlin, died on April 26 at the age of sixty-eight years.

DR. E. VON PFLEIDERER, professor of philosophy at Tübingen, has died at the age of sixty years.

THE mineralogist, Friedr. Baron Rosen, has died at Kassan at the age of sixty-eight years.

THE seventeenth annual meeting of the Association of American Physicians was held in Washington on April 29 and 30, Dr. J. C. Wilson presiding. Officers for next year were elected as follows: *President,* James Stewart, Montreal; *Vice-President,* William T. Councilman, of Boston; *Secretary,* Henry Hun, of Albany, N. Y.; *Treasurer,* J. P. C. Griffith, Philadelphia, and *Recorder,* S. Solis Cohen, Philadelphia. A proposition was made that will be voted on next year to increase the membership of the Association from 125 to 150.

THE agricultural appropriation bill, as introduced in the House, carries an appropriation of $5,115,570. Compared with the current fiscal year the appropriations are as follows:

	Current fiscal year.	1902–3.	Increase.
Office of Secretary	$71,670	$73,690	$2,020
Weather Bureau...	1,148,320	1,251,760	103,440
Animal Industry...	1,154,030	1,247,180	93,150
Plant Industry....	496,680	601,780	105,100
Forestry...........	185,440	282,860	97,428
Chemistry.........	35,800	73,200	37,400
Soils...............	109,140	168,960	59,820
Entomology........	36,200	57,200	21,000
Biology...........	32,800	45,600	12,800
Accounts..........	18,900	24,100	5,200
Publications.......	198,020	228,020	30,800
Experiment stations	789,000	792,000	3,000
Silk investigations.	Nothing.	10,000	10,000
Total increase.	....	....	581,150

The appropriations in recent years have been as follows:

For 1897–98 the appropriation was $3,182,902.

For 1898–99 it was $3,509,202, an increase of $326,300.

For 1899–1900 it was $3,726,022, an increase of $216,820.

For 1900–1901 it was $4,023,500, an increase of $297,478.

For 1901–2 it was $4,582,420, an increase of $558,920.

EIGHTY-THREE thousand acres of forest land have been purchased by the State Forestry Commission in Central Pennsylvania.

THE 73d anniversary meeting of the Zoological Society, of London, was held on April 29. The report of the council for the past year was read by Mr. P. L. Sclater, secretary. It stated that the number of fellows on December 31 last was 3,338, an increase of 88 on the corresponding period of the previous year and showing a larger number of fellows on the Society's books than in any year since 1879. The income of the Society during the past year has been £29,350, showing an increase of £577 over that of the previous year. The ordinary expenditure for 1901 had amounted to £27,526, being £1,187 more than the ordinary expenditure of 1900. The extraordinary expenditure paid in 1901, amounting to £4,530, had been devoted entirely to new buildings and works. The balance carried forward on December 31 last was £1,121. The number of animals living in the Society's gardens on December 31 last was 2,922, of which 789 were mammals, 1,575 birds, and 558 reptiles and batrachians. Amongst the additions made during the past year ten mammals, 58 birds, 21 reptiles, three batrachians, and two fishes were registered as new to the collection. The Earl of Crawford, Mr. F. Du Cane Godman, Dr. A. Günther, Sir Harry Johnston, and Mr. E. Lort Phillips were elected into the council in the place of the retiring members. The Duke of Bedford was reelected president, Mr. Charles Drummond treasurer, and Mr. Sclater secretary of the Society for the ensuing year.

A PHYSIOGRAPHIC Conference will meet at the State Normal School, Westfield, Mass., Saturday morning, May 17, at ten o'clock. The subject to be discussed at the forenoon session will be 'Laboratory Work on Features of the Land for High and Normal Schools.' The discussion will be opened by Professor Richard E. Dodge, of the Teachers College, Columbia University, Miss Mary I. Platt, of the Brookline High School, and Mr. William H. Snyder, of the Worcester Academy. In the afternoon, Professor William Morris Davis, of Harvard University, will conduct the members of the conference over the Westfield terraces.

PROFESSOR FREDERICK STARR, of the University of Chicago, has issued a series of type portraits of South Mexican Indians. The series includes sixty platinum photographs, which represent thirty subjects, front and profile views being given of each. Twenty-three men and seven women make up the series. There is one man from each of the tribes that Professor Starr has visited. The portraits are simple heads, and are of actual size of life. Only fifty sets, are to be issued.

ACCORDING to cablegrams to the daily papers, Professor Behring has published a book in Berlin proving that the bacilli of human and bovine tuberculosis are identical, the seeming differences between them resulting from the capacity of the bacilli to accommodate themselves to the organism in which they live. The writer says he has successfully infected cattle with virus from human beings, producing thereby fatal animal tuberculosis. He also says he has rendered cattle immune against tuberculosis by vaccinating them when they are young.

AT the annual meeting of the California State Medical Society, held April 15–17, the following resolution was adopted: "Whereas, the Mayor of the city of San Francisco has seen fit to remove the so-called old Board of Health; and whereas, the chief executive of the city has stated that he has determined, after a prolonged personal investigation, that bubonic plague has never existed in San Francisco; and whereas, the position is absolutely unsupported by any competent, unprejudiced physician who has made personal examination of suspects or alleged cases of plague before or after death, or who has examined the bacteriological evidence presented, and is further in direct conflict with the findings of the Federal Government experts and Special Commission; therefore be it *Resolved,* That the Medical Society of the State of California emphatically condemns this action on the part of the Mayor of San Francisco, and at the same time endorses the position always maintained by the old Board of Health in its sanitary defence of the people of the city of San Francisco and of the country at large.

WE have been requested to print the following note:

Between September 21 and September 28, 1902, the Association of Natural Phylosophers and Physicians will hold its 74th Annual Congress at Carlsbad, the Austrian Spa. As on former occasions the rule that lectures and debates may be carried on in any language of the world, will be adhered to, and to English, American, French, Spanish, etc. Natural Phylosophers and Physicians the same privileges will be again accorded as the ordinary members of the association are in the habit of enjoying. It is estimated that between 6,000 and 8,000 representatives of Natural Phylosophy and Physicians will gather on that occasion at Carlsbad, and great preparations are made now already, at Carlsbad, to receive the members and friends of this famous association. Nearly all the principal professors of the Berlin, Vienna, Prague and most of the other Continental universities and high colleges will again be present, and 28 different branches of modern and ancient sciences will form the programme for the lectures and debates. As several hundred inhabitants of Carlsbad understand and speak English, the place being annually frequented by a few thousand bathers and tourists from England and America, the facilities, comfort and convenience available for English and American Natural Phylosophers and Physicians, at this year's congress, will be by far greater than on any former occasion, but those intending visitors of the congress who wish to hold lectures should give notice of this intention at an early date, as the number of lecturers will be very large. We are requested by the secretary of the association to inform our readers that this Association of Natural Phylosophers and Physicians pursues solely and exclusively the object of promoting and developing all branches of science, and that any other object of whatever kind it may be, is strictly excluded. At the small exhibition of scientific objects which will be held in connection with the Congress, no charge will be made to exhibitors for the space required, nor will any entrance fee be asked from visitors. Enquiries or letters should be addressed to 'The 74th Congress of Natural Phylosophers at Carlsbad.' No stamp for reply need be enclosed.

WE learn from the London *Times* that Major Ronald Ross has submitted to Sir Alfred L. Jones, chairman of the Liverpool School of Tropical Medicine, a report on the anti-malaria work accomplished on behalf of the school in Freetown by Dr. Logan Taylor since his arrival last July. Employing about seventy men, Dr. Taylor has drained nearly the whole of the most pestilential parts of the town. The areas which have been dealt with were formerly full of hollows, pits and ill-made drains, which in the rainy season contained pools of stagnant water, breeding swarms of malaria-bearing mosquitoes. In addition to the work of drainage Dr. Taylor has employed a gang of men to collect old tins, bottles and other rubbish from the houses, and 2,257 cart-loads of such refuse have been removed and 16,295 houses have been visited. The effect of these measures has been a demonstration of the possibility of getting rid of mosquitoes in Freetown, and therefore, probably, in any town. The moral which Major Ross draws from the results of the work done is that in order to make the principal West African stations healthy they must be rendered scrupulously dry and clean. Nothing else will remove the malaria in them on a large scale. To attain this object the colonies must be prepared to maintain proper conservancy gangs, superintended by efficient health officers. As regards the effect of the anti-mosquito measures on the health of Freetown, Major Ross says that he was struck by the great change in the demeanor of the Europeans. Two and a half years ago every one was gloomy; now the Europeans look as cheerful and well as they look in India. Arrangements have been made for Dr. Taylor to proceed at once to Cape Coast, in order to start anti-malaria work there, with the assistance of the governors, as the mortality at present is very high.

We take from the Mexican *Herald* the following recommendations passed by the second International Conference on January 29: The second international American conference recommends to the republics here represented, that an 'American International Archeological commission' be formed, through the appointment, by the president of each of the American republics, of one or more members of such commission; that each government represented shall defray the expenses of its commissioner or commissioners; that such commissioner shall be appointed for five years, and that they shall be subject to reappointment; that appropriations for the expenses incidental to the prosecution of the work and publications of the reports of the archeological commission shall be made by the respective governments subscribing on the same basis as that on which the bureau of the American republics is supported; that the first meeting for the organization of the commission, the election of officers and adoption of rules, shall occur in the city of Washington, District of Columbia, United States of America, within two years from this date; that the accounting department of the commission shall be exercised by the bureau of the American republics; that this commission shall meet at least once in each year; that the commission shall have the power to appoint sub-commissions, which shall be charged specially with the explorations, or other work committed to their care; that sub-commissions may be appointed, which shall cause the cleaning and preservation of the ruins of the principal prehistoric cities, establishing at each of them a museum to contain objects of interest; to found an 'American international museum' which is to become the center of all the investigations and interpretations, and that it be established in the city selected by the majority of the republics acquiescing in this recommendation. Committees shall also be appointed to clean and conserve the ruins of ancient cities, establishing in each of them a museum to contain the antiquities that may be gathered, and which is to afford all possible accommodations to the visitors. The archeological commission and the subcommittees it may appoint will be subject in all matters to the laws of the signatory countries.

UNIVERSITY AND EDUCATIONAL NEWS.

President Schurman took the occasion of Lord Kelvin's visit to Cornell University to announce that the necessary $250,000 required by Mr. John D. Rockefeller's gift was assured, and that $250,000 will be spent in erecting a hall of physics.

Yale University has been made the residuary legatee of Edward W. Southworth, New York City, and it is said may receive as much as two or three hundred thousand dollars from the estate.

Vassar College has received a library building from a donor whose name is at present withheld.

Dr. A. E. Kennelly, of Philadelphia, has been appointed professor of electrical engineering at Harvard University.

Dr. Abraham Jacobi has resigned the chair of the diseases of children in Columbia University.

Dr. B. F. Kingsbury has been appointed to the chair of human physiology in Cornell University. At present Dr. Kingsbury is at the University of Freiburg; he will assume his duties for the college year 1903–1904. Meantime the classes in physiology will be instructed by Professor B. G. Wilder and Dr. P. A. Fish.

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, MAY 23, 1902.

CONTENTS:

THE PITTSBURGH MEETING OF THE AMERICAN ASSOCIATION.

THE American Association for the Advancement of Science will hold its fifty-first annual meeting at Pittsburgh, Pa., from June 29 to July 3, and the several scientific societies affiliated with it will hold their meetings at the same place and at about the same time. The Association has never before held a meeting at Pittsburgh, but that city is so easily reached from all parts of the country and is a center for so much of scientific interest that the meeting may be expected to be one of the largest and most successful in the history of the Association. The preliminary announcement, now in press and about to be issued to members, shows that the local arrangements have been made with great care, and that everything possible has been done to insure the success of the meeting. Dr. W. J. Holland, director of the Carnegie Museum, is chairman of the local executive committee, and Mr. George A. Wardlaw, P. O. Box 78, Station A, Pittsburgh, is the local secretary.

From the advance sheets of the announcement we take the following facts: The council will meet at Hotel Schenley at noon on Saturday, June 28, and the opening session of the Association will be held at 10 o'clock A.M., on Monday, June 30, in the Music Hall of the Carnegie Institute.

The meeting will be called to order by the retiring president, Professor Charles Sedgwick Minot, of the Harvard Medical School, who will introduce the president-elect, Professor Asaph Hall, U. S. N. The usual addresses of welcome will then be made and President Hall will reply. After the announcements by the general, permanent and local secretaries the general session will adjourn, followed by the organization of the sections in their respective halls.

On Monday afternoon the vice-presidents are expected to give their addresses as follows:

Professor James McMahon, Cornell University, before the Section of Mathematics and Physics.

Professor D. B. Brace, University of Nebraska, before the Section of Physics.

Professor H. S. Jacoby, Cornell University, before the Section of Mechanical Science and Engineering.

Professor C. R. Van Hise, University of Wisconsin, before the Section of Geology and Geography.

President David Starr Jordan, Leland Stanford Junior University, before the Section of Zoology.

Mr. B. T. Galloway, U. S. Department of Agriculture, before the Section of Botany.

Dr. J. Walter Fewkes, Bureau of American Ethnology, before the Section of Anthropology.

Mr. John Hyde, U. S. Department of Agriculture, before the Section of Social and Economic Science.

The address by the retiring president, Professor Charles Sedgwick Minot, will be given in the Music Hall, Carnegie Museum, on Tuesday evening. Following this address there will be a reception to the members and guests of the Association. It is expected that the Council will meet daily at 9 A.M., and that the usual brief general session will assemble at 10 A.M., the meetings of the sections following, with a brief interruption for lunches, until 4 o'clock P.M. On Wednesday evening the general committee will meet at 9 o'clock at the Hotel Schenley for the election of officers and agreement on time and place for next meeting. The closing general session will be held on Thursday evening.

The Hotel Schenley has been selected as 'headquarters.' It is situated between Forbes Street and Fifth Avenue, opposite the entrance to Schenley Park, and is within easy walking distance of the Carnegie Institute and the other buildings in which the Association and Affiliated Societies will meet. Delegates arriving from the East via Pennsylvania Railroad, and intending to stop at the Hotel Schenley or one of the East End boarding houses, should leave the train at the East Liberty Station instead of going into the Union Station in town. All trains on the main line of the Pennsylvania road stop at East Liberty. A number of other hotels and the addresses of numerous boarding houses within easy reach of the place of meeting are given in the announcement.

By the courtesy of the Board of Trustees of the Carnegie Institute, the Board of Trustees of the Bellefield Presbyterian Church, the Board of Trustees of the First United Presbyterian Church, the Board of Trustees of the Oakland Methodist Episcopal Church, the School Board of the Bellefield district and Mr. Wm. Falconer, Superintendent of Schenley Park, the meeting of the Association and Affiliated Societies of the Pittsburgh Convention will be held in the Carnegie Institute, the Bellefield Presbyterian Church, The First United Presbyterian Church, the Oakland Methodist Episcopal Church, the Bellefield School House, and the Botanical Lecture Hall of the Phipps Conservatory. All these buildings are located in or close to Schenley Park and are within five minutes' walk of the Hotel Schenley.

A railroad rate of one fare and one third for the round trip has been granted by the Trunk Line Association and the Central Passenger Association. The same rate is expected and will probably be given by the

New England Passenger Association, the Western Passenger Association, the Southeastern Passenger Association, and the Southwestern Passenger Association. The Trans-continental Association has not granted a special rate for this Convention but suggests that delegates using their lines avail themselves of the privileges afforded by getting a nine months' tourist ticket. This means transportation from extreme western points to territory granting above rate, at two cents per mile, and is about equivalent to a rate of one fare and one third for the round trip. An extraordinary concession has been made by the Trunk Line Association and the Central Passenger Association in extending the return limit of tickets to August 31, 1902.

Arrangements have been made for a number excursions and others will be announced in this JOURNAL.

The Permanent Secretary has been notified that the following societies will meet in affiliation with the Association at the Pittsburgh meeting. The decisions of others may be pending.

The Geological Society of America.—This Society will meet on Tuesday, July 1, in the lecture room of the Oakland M. E. Church. The Society will assemble on Friday, June 20, for an excursion through the coal measures of western Pennsylvania and northern West Virginia, under the guidance of Dr. I. C. White. President, Dr. N. H. Winchell; Secretary, Professor H. L. Fairchild, Rochester University, Rochester, N. Y.

American Chemical Society.—A general meeting of the American Chemical Society will be held on Monday and Tuesday, June 30, July 1, in the lecture room of the Bellefield Presbyterian Church. The first session will convene immediately after the organization of Section C of the A. A. A. S. President, Ira Remsen; Secretary, Dr. A. C. Hale, 352A, Hancock Street, Brooklyn, N. Y.

Society for the Promotion of Agricultural Science.—The first session of this Society will be held in the west room, Carnegie Lecture Hall, Carnegie Institute, on Monday, June 30. President, W. H. Jordan; Secretary, F. M. Webster, Wooster, O.

Botanical Society of America.—The meetings of the Botanical Society of America will be held in the Botanical Hall of the Phipps Conservatory, June 30, July 3. President, Dr. J. C. Arthur; Secretary, Dr. D. T. MacDougal, Bronx Park, New York City.

American Microscopical Society.—This Society will meet in a designated room in the Phipps Botanical Hall, on Friday and Saturday, June 27–28. President's address on the evening of the 27th. Regular sessions morning and afternoon, both days. President, Charles E. Bessey; Secretary, Henry B. Ward, Lincoln, Nebr., University of Nebraska.

American Folk-Lore Society.—Papers offered by members of the American Folk-Lore Society will be read in the sessions of Section H, A. A. A. S., at which similar papers will be read in the audience room of the Bellefield Presbyterian Church. Secretary, W. W. Newell, Cambridge, Mass.

Association of Economic Entomologists.—This Association will hold its fourteenth annual meeting in the west room of the Carnegie Lecture Hall, Carnegie Institute, on Saturday and Monday, June 28 and 30. President, Dr. A. D. Hopkins; Secretary, Professor A. L. Quaintance, College Park, Md.

Society for the Promotion of Engineering Education.—This Society will hold its meetings in the Lecture Hall of the Carnegie Institute, on Friday and Saturday, June 27–28. President, Professor Robert Fletcher; Secretary, Professor H. S. Jacoby, Cornell University, Ithaca, N. Y.

American Physical Society.—The permanent secretary is informed that this Society has requested its Council to arrange for a summer meeting in connection with Section B, A. A. A. S. At the time of this writing the action has not been taken, but information from the Secretary shows that the meeting will in all probability take place. In that case this Society will meet June 30 to July 3, in connection with Section B, A. A. A. S., in the middle room of the Carnegie Lecture Hall, Carnegie Museum. President, Professor Albert A. Michelson; Secretary, Professor Ernest Merritt, Cornell University, Ithaca, N. Y.

Sigma Xi Honorary Scientific Society.—An informal general meeting will be held on some convenient evening to be announced later. The President is Professor S. W. Williston, University of Kansas, Lawrence, Kans. The Secretaries are Professor E. S. Crawley, University of Pennsylvania, Philadelphia, and Professor James McMahon, Cornell University, Ithaca, N. Y.

THE FOUNDATION OF A NATIONAL ANTHROPOLOGICAL SOCIETY.

During the last twenty-five years anthropology has made great advances in our country. Before the year 1877 attempts had been made here and there to collect information in regard to our native tribes. The report of 1822 on the Indians, by Jedidiah Morse, the monumental work by Schoolcraft, and the many important investigations connected with the geographical and geological surveys of the Western States, are witnesses of an early interest in the history of our native tribes and of their remains. The first attempt to organize ethnological work was the establishment of the Bureau of American Ethnology through the activity of Major Powell. It took a long time, even after the organization of the Bureau, before the necessity for careful training of anthropologists became clearly understood; and it was only in 1888 that, through the appointment of F. W. Putnam as professor, anthropology was introduced in Harvard University as a subject of instruction. Since that time great strides have been made, and the list of anthropological courses given in colleges and universities, which was recently published by Mr. MacCurdy,* is an encouraging sign of the growth of interest in our science.

The increasing interest in anthropology also led to the formation of a number of societies specially devoted to this subject. The first anthropological society founded in America was the American Ethnological Society of New York, established in 1842 by Albert Gallatin. This society, in course of time, became dormant. Meanwhile, in 1882, the American Association for the Advancement of Science recognized the claims of anthropology by founding an anthropological section. In 1879 an Anthropological Society was established in Washington. In 1895 the New York Academy of Sciences established a section of anthropology and psychology; and in 1899 the American Ethnological Society in New York was resuscitated. It seems but right to mention in connection with these societies the American Folk-Lore Society, which was established in 1888, and which has done much valuable anthropological work. Besides this, a number of smaller informal societies might be mentioned, such as the Anthropological Club at Harvard University.

At the present time we find, therefore, three important societies devoting themselves to the advancement of anthropology. These are the Anthropological Section (H) of the American Association for the Advancement of Science, the Anthropological Society of Washington, and the American Ethnological Society. The first of these is national in its character; the other two are essentially local societies, although both have a number of members scattered all over the country.

The rapid advances of anthropological work in America make it desirable to consider whether the development of anthropological societies cannot be so directed as to lead to a thorough organization that will be beneficial to the further development of anthropology.

The objects of scientific societies may perhaps be briefly defined as follows: First, to give opportunity for the discussion of scientific problems among students, and thus to further the advancement of science; secondly, to disseminate knowledge through the publication of the results of investigations; thirdly, to create new interests by bringing the progress of scientific research to the attention of the lay public. This last point, while not immediately contributing to the advancement of science, must be considered as of fundamental importance, particularly in our country, because no science can flourish that has not the

* Science, February 7, 1902.

support of public opinion. It is therefore incumbent upon scientists to sustain societies which spread their activities as widely as possible.

The constituencies of national and of local societies are naturally different, the national society taking its members from all over the country, while local societies are primarily confined to the inhabitants of a certain city, or, at most, of a limited district. For this reason the means applied by local and by national societies to extend their membership cannot always be the same.

A difficult problem often arises among those societies which are most successful in popularizing the subject matter of their science, because the lay members largely outnumber the scientific contributors. Wherever this is the case there is a tendency towards lowering the scientific value of discussion, because, out of regard for the general public, purely technical matter is often excluded from the discussions. Thus the necessity arises of giving opportunity for technical discussions, in order to enable the society to fulfill its purely scientific mission, namely, to serve the advancement of science by means of discussions among scientists, and by the publication of technical papers. The greater the public interest in a science, and the less technical knowledge it appears to require, the greater is the danger that meetings may assume the character of popular lectures. Anthropology is one of the sciences in which this danger is ever imminent, and in which for this reason great care must be taken to protect the purely scientific interests.

It seems to my mind that the problem of how to effect the best organization of anthropologists cannot be solved without a discussion of the general organization of scientific societies. The problems with which we are confronted in various branches of science are practically the same, and the general tendencies that manifest themselves should be considered in guiding our actions.

At the present time our active societies may be classed as follows: First, we have a group of miscellaneous societies, such as our local academies, in which all sciences are represented with a large lay membership; secondly, there are local special societies with unlimited membership, such as our geographical, anthropological and zoological societies; thirdly, the American Association for the Advancement of Science represents a class by itself, similar in character to the local academies, but intended to embrace the whole country. There are a number of somewhat special societies of a similar character, which, however, are more or less devoted to applied science. All these societies cater to a very great extent to the lay public. As a reaction to the popularizing tendencies of these societies, and intended to fill the demand for an opportunity for technical discussion, a number of purely scientific national societies and the American Society of Naturalists have arisen. The formation of the National Academy is also partly due to this demand.

It has evidently been found impossible to harmonize the popular and technical elements in the meeting of the general societies, else it would be difficult to understand why the national purely scientific societies should have arisen, notwithstanding the existence of the American Association for the Advancement of Science. The fact that so many societies of this character have sprung up recently shows clearly that it is necessary to provide for purely scientific meetings.

A consideration of the methods of publication of our societies brings out a number of points of considerable interest. We find that throughout the country it is the practice of every society which publishes accounts of its work, to endeavor to build up a library by exchanging its publications with those of societies treating allied subjects. The wider the scope of the society, the more ambitious the scheme of the library. It seems to my mind that this method of procedure is not in accord with existing conditions. The administrative machinery of a society is not adapted to manage an efficient library. The available funds are, on the whole, too slender to admit of adequate binding and shelving of the books, not to mention the impossibility of having the library accessible at all times to every one who needs it. I do not believe that a single city could be found in which a publishing society exists that has not a public library in which books are properly cared for, and which would not supply all the demands immeasurably better than a scientific society could do. I do not need to bring forward specific examples of the complete break-down of society libraries, because cases are too numerous. It is only in technical or semi-technical societies, which possess buildings of their own, and which to a certain extent partake of the character of clubs, and whose fees are accordingly high, that attempts at managing a library have been at all successful.

If it were once recognized that the efforts of societies to build up libraries are necessarily futile, and should be left to organizations established for the care of books, the whole question of publication and distribution of publications would assume a new aspect. As it is now, most of our societies accumulate libraries where they are neither needed nor wanted, and furthermore they distribute their publications among people to whom they are an encumbrance. It should be clearly understood that among the members of our societies there are a great many who join, not on account of any specific interest in the subject of the society, but simply because they consider it proper to advance the interests of science. Most of these would much rather not receive the publications of our societies than be so encumbered. It is only recently that one or the other society has adopted the method of requiring its members to express their wish to receive the publications of the society before sending them.

If the effort to build up a library, and the miscellaneous distribution of publications were discontinued, a very considerable saving in the funds of each society could be effected, and the available funds for publication would be materially increased.

If once the accumulation of books were left entirely to existing libraries, scientific societies of good standing would have a right to expect that each library would subscribe to their publications; and in this manner it would be feasible to establish publication on at least a partially paying basis. We should not forget, however, that many of our societies are not strong enough to publish journals which are so important that every great library would subscribe for them. It seems to my mind that here, more than anywhere else, is an opportunity to make our work effective by better organization. The anthropologists of this country found it advantageous to combine in regard to publication. The Anthropological Society of Washington has published for a long series of years, under heavy sacrifices, the *American Anthropologist.* In 1899 the Society gave up the journal, and allowed it to become a national journal. It has increased in size, and it is now supported as their official journal by the Washington Anthropological Society and by the American Ethnological Society. If we imagine that such concentration were to take place in other societies also, many of the smaller journals might be combined, and might become of such importance that libraries would have to subscribe to them. It is perhaps too much to hope for a realization of such a plan in the near future, because it might seem to encroach too much upon the individuality of each society.

There is however one case in which the advantage of a proceeding of this sort seems so obvious that I wish to mention it.

Our local academies of science were organized at a time when men of scientific interest were few and far between, and when it was necessary for all of them to come together and to work together. The publications which have developed from these sources are miscellaneous in character. An astronomical paper may be followed by one on geology, which in turn may be followed by one on anthropology, botany, or even philology. For this reason the papers published in such miscellaneous collections are hardly noticed, and, if noticed at all, are quickly forgotten. The publications of our local academies are an excellent medium for burying good work. It would seem that, if our academies could disregard the sentimental interest in the continuance of their series of publications, and could give their support to existing special journals, or if several academies would combine in such a manner as to make it feasible to publish series relating to various sciences, the effectiveness of the scientific work accomplished would be immensely increased, and I venture to say that in this manner much of our scientific publication could be made nearly self-supporting.

In order to bring this about, cooperation between the various academies would be necessary. In fact, the local academy would assume a function entirely different from what it is at the present time. It would become what the Washington Academy of Sciences was intended to be, and what the Scientific Alliance of New York is trying to be—a clearing-house between the various local societies. Evidently a development of this kind would lead to the establishment of a number of national societies, each with its local branches of greater or less independence; and the local branches, representing various sciences, together would form a local academy. It would seem that in this manner the national as well as the local interests of each science might be fully guarded.

I believe that to a certain extent our societies are developing in this direction. The establishment of the national, purely scientific societies to which I alluded before, and their relation to the American Association for the Advancement of Science, are in line with a movement of this kind. If the general interests in any science were concentrated in one national society, it might be considered advantageous for such a society either to take the place of, or to affiliate itself closely with, the corresponding section of the American Association for the Advancement of Science, and for the Association to assume the same function in relation to all the national societies that the local academy assumes in relation to the local societies. These ideas were well outlined by Professor Cattell in the annual discussion before the American Society of Naturalists at their meeting in Chicago, 1901.

Anthropology is in one respect better situated than most of the older sciences, because, comparatively speaking, little has been done. The interests that will arise during the coming twenty years are certainly immeasurably greater than the interests which have become organized during the past twenty years. It might therefore seem feasible to direct, to a certain extent, the growth of our societies in lines that may seem desirable. Up to the present time the Anthropological Section of the

American Association for the Advancement of Science has performed the functions of a national society. During the last few years the Section has assembled every winter at the same time and place as the American Naturalists, and has tried to hold a meeting which was intended to be more strictly technical than the summer meeting. These meetings have decidedly grown in interest and in importance.

Recently the question has been raised whether Section H is the most efficient medium of bringing together all those scattered individuals who take an interest in anthropological matters. I thoroughly believe that this can be done.

It should be borne in mind that the effort to bring together from all over the country those interested in the advancement of any special branch of science has an intimate relation to the more general objects of creating an organization in which the whole interest in science centers. This is the function of the American Association for the Advancement of Science; and if this aim is borne in mind, the Association is bound to become a factor of great importance in molding the development of scientific interests in our country. It seems to my mind that the general scientific interests would suffer if any new popular scientific societies were created that are not affiliated as intimately as possible with the American Association for the Advancement of Science. If we endeavor to obtain, from all over the country, lay members for an anthropological society, we should endeavor at the same time to make them members of the American Association for the Advancement of Science. It might perhaps seem that the necessity of contributing the amount of the membership fee for each member of a special society to the American Association would not be in the interest of the special society, but I am inclined to believe that this would be a narrow point of view to take. The large increase in membership of the American Association which could be effected by bringing the members of all special societies into the Association could not fail to give such a tremendous impulse to the Association, and to make it so much more powerful, that it would retroact upon the single societies, and that it would facilitate their growth.

It seems to my mind that this point of view should determine our further actions in regard to the organization of anthropological interests. I should advocate a movement originating in the American Association for the Advancement of Science, by which the Section of Anthropology should be authorized to take the name of a national anthropological society, and to levy assessments for their own particular purposes, and by which only such members of the American Association should become members of the Section as fulfill the requirements set by a special council selected by the Section. This would lead to a distinction between members at large and members united in special societies—a process which I believe would be wholesome for the advancement of the best interests of science.

It seems to me that we should not be misled under present conditions by the mere desire to obtain as rapidly as possible as much financial aid to anthropology as we can secure, but should in all our movements be controlled by what seems to be for the best permanent scientific interests of the country.

The reasons for our desire to bring together all those who are interested in anthropology are twofold. The work of a national society will be beneficial to them by stimulating their interest and bringing them into contact with their co-workers all over the country. On the other hand, every new member will help the society to enlarge its activity in establishing anthropology on a firmer basis. Although, therefore, the establishment of close relations between all individuals all over the country who are interested in anthropology seems to be of great importance, the reserving of an opportunity for discussion among scientists alone must not be lost sight of. At the present time the number of trained anthropologists is so small that it is doubtful if there is any immediate necessity of providing for such meetings. A conservative estimate of the number of anthropologists who can lay claim to a fairly symmetrical training, and who contribute to the advance of anthropology, would hardly exceed thirty. At the same time the number of young men who devote themselves to this science is constantly increasing. Harvard, Columbia and Chicago universities are constantly training new men, and the breadth and thoroughness of their training are constantly increasing. If therefore the time is not ripe for providing for strictly technical meetings, it is certainly not far distant. In most sciences the organizations which are providing for technical meetings, and those which provide for the general interest of the science, have become distinct organizations. I have hinted before at the reason which led to this condition of affairs. The foundation of societies of specialists was partly a reaction against the popular character of the meetings of the older societies. The experiences of the last few years seem to suggest that a separate organization gives a better assurance of preserving the purely scientific character of meetings than attempts to distinguish between two kinds of meetings of the same society—technical meetings and popular meetings—or through the division of the membership of a society into two classes, as fellows and members. Nevertheless it is not certain that adequate provisions for technical meetings might not be made in the general society. I wish to call attention here to the methods of scientific societies abroad, many of which have also a miscellaneous membership. The scientific work of these societies is carried on successfully, notwithstanding the presence of lay members, and the success of such meetings depends simply upon the courage of the presiding officer, and of the speaker to discuss before his audience technical matters which may be beyond the comprehension of a majority of the audience. I do not venture to say whether an attempt of this kind could be successful here.

I believe the reasons that have been adduced, and which have been much discussed among a number of anthropologists, are weighty enough to induce us to consider carefully if the time has come for a better organization of anthropological work all over the country, and what steps may be the most advantageous to take.

FRANZ BOAS.

EXCERPTS FROM THE REPORT OF THE CENSUS COMMITTEE OF THE AMERICAN CHEMICAL SOCIETY.

THE Census Committee of the American Chemical Society sought to learn as accurately as possible the progress during the last twenty-five years, and how to better the conditions for the development of chemistry in America. A mere statement of the conditions without further comment would hardly secure that end. It was therefore necessary to gather statistics of the most varied character. Naturally such a report could not be complete, as the members of the committee had various other cares demanding their attention, and the means at their command were limited. Sufficient data, however, were secured to give cause for some gratification and at the same time to indicate directions for much home mission work among American chemists. This article, in brief, must merely state a few points of interest dealt with more in detail by the committee. Over two hundred colleges, including the leading universities of the United States, gave the committee statistics. Scarcely a dozen answers came from Canada and no requests for information were sent to Mexico.

A lengthy table is given showing the increase in the number of students in chemistry (inorganic, organic, physical and agricultural) during the past twenty-five years. While the figures are not to be relied upon for several reasons, some very interesting information was gained; for instance, there is a very marked number of students specializing in chemistry; the courses have been much diversified by means of the increase in the number of instructors, teaching fellows, laboratory assistants, etc.

In regard to equipment: Large sums have been spent by many institutions, some having even been established since the founding of the American Chemical Society. A few chemical departments reported large endowments. While in many cases through private beneficence institutions have been provided with commodious and in some instances magnificent laboratories, as at Yale, Columbia, Chicago, Cornell and Leland Stanford, Jr., and in others, as the Universities of Nebraska and Washington, the states have supplied the needs in many departments, there is still a crying demand for better equipment and better accommodation. Some few reported their equipment as sufficient.

While much information in regard to buildings, floor-space, etc., was secured, an itemized statement of such was impracticable. A conservative statement, averaging all, is that the accommodations for students, teachers and chemists in America have increased in the proportion of one to twenty-five.

Two interesting tables are included in the report touching directly upon the number of professors teaching *organic chemistry;* the number of students taking lecture work in organic chemistry, laboratory work in organic chemistry; and the number of professors, instructors and students doing research work in organic chemistry. It appears almost beyond conception to realize that in only five or six colleges were researches in organic chemistry conducted in 1876, while now over thirty institutions offer excellent opportunities for such researches and the total number of students carrying them out in these institutions is much over a hundred (1900). Twenty-five volumes of the *American Chemical Journal* speak eloquently of American researches in organic chemistry. (Report on Organic Chemistry was prepared by W. A. Noyes.)

The report contains a complete history of the development of *physical chemistry* in America (by Louis Kahlenberg). At the founding of the Chemical Society there was not a single instructor of physical chemistry in America. In fact it may be said that this phase of the subject has been recognized only within the last decade, yet at present there are several chairs of physical chemistry in America, and all of the more important institutions offer instruction in that subject under an adjunct professor or instructor in charge of it. An outline is given also of the aspirations and aims of physical chemistry in America, and a promising indication of accomplishment is had in the *Journal of Physical Chemistry,* now in its fifth volume.

Agricultural Chemistry (by C. L. Parsons).—The report in reviewing agricultural chemistry has considered the establishment of many of the agricultural colleges a few years preceding the founding of the Society. Not long afterward, in 1882, the Association of Official Agricultural Chemists, which has done and is doing so much for securing standard and satisfactory analytical methods, was organized. The Experiment Stations established in 1887, the present Soil Surveys and finally the establishment of a division of chemistry in the department of agriculture are simply cited as marks of progress. Although full courses of chemistry are given at all of these land-grant colleges, many of which have some of the very best equipped laboratories and offer the most extensive election of work in chemistry, the total number of agricultural chemists or students taking agricultural chemistry is proportionately small (1,555). A full table is given showing the proportion of students in all courses in these state colleges who receive instruction in chemistry, proportion of students in agricultural courses who receive chemical instruction, with special reference to agricultural products, plant life, fertilizers, etc.

Industrial or Technical Chemistry.—In considering that phase of the subject the committee had to consider it from two standpoints: first, the amateur; and second, the professional.

In regard to the former a quotation from Priestley's 'Essay on Education' is fitting: 'It seems to me a defect in our public course of education that a proper course of study is not provided for gentlemen who are to fill the greatest stations of actual life distinct from those who are adapted to the learned professions.' With this was taken a course of lectures in industrial chemistry —really economics, chemically considered —as offered in many institutions.

In regard to the second class, professional chemists, George Hamilton, in writing to Sir Alfred Hickman, ex-president of the British Iron Trade Association, among other things said: 'Chemical research, concentration of capital, thorough technical education, improved industrial organizations have made, within recent years, greater advance in America than here.'—*Nature.* The most timely address of the retiring president, Wm. McMurtrie, was referred to.

The rapid growth of chemistry has naturally developed undesirable phases, some beyond help, but others that may be corrected:

First, there has been a tendency to permit many students to specialize before the proper foundation had been laid. The result has been the making of mere analysts and not chemists.

The second, in a measure dependent upon the first, may be stated in the words of one of the respondents: 'It seems that chemists are underpaid; while a furnace-man gets from $150 to $300 per month, the chemist gets about $50 to $100 per month.'

Third, according to another respondent: 'Our country is a long way behind the times in the matter of cooperation between manufacturers and universities.'

Fourth, there is a notable percentage of chemists, practical and teaching, especially the latter, who are not members of any chemical society, according to the latest official registers of Germany, England and America.

Fifth, the Chemical Society ought to take some steps to set the seal of approval for all graduates in first-rate chemical courses and to disapprove of self-made and half-made chemists.

A very encouraging state of affairs was observed in regard to the increase in the number of members of the American Chemical Society. Yet it is noticeable that teachers in many of the smaller institutions, and assistants and fellows in the larger ones, have not allied themselves with any chemical society. Suggestions were offered and steps have already been taken, whereby this, in a measure, can be remedied.

Very interesting and gratifying information was secured showing that while a larger number of students seek the degree of Doctor of Philosophy in Europe now than in 1876, the percentage is vastly less. The small institutions reported almost unanimously that their students sought the larger American universities for their final work, at the same time the great home institutions reported that many of the best men still seek instruction abroad after having secured the American degree. The German degree does not possess, compared with the American, the same financial value it held in 1876.

It was learned, and regretted, that as yet there is little exchange of graduate students for a term or so among American universities. Finances, arrangements of terms, required residence and competition for students are factors that interfere with the accomplishment of this desired end, which will doubtless shortly be solved for chemists in the larger movement afoot.

A statement of the new fields in which chemistry has been recognized as a necessary factor is mentioned in the report, but it was learned that the appreciation of chemistry and its application has not been uniform throughout the country by any means. It is a fact, easily established, that those sections which have been most progressive or have grown most rapidly utilize most extensively the services of chemists. This is largely, however, an economic problem, for twenty-five years ago profits were immense and wastes enormous; now with competition, local and foreign, the value of waste is appreciated and chemistry regulates the control of that waste. One informant wrote: 'Twenty-five years ago I do not think there was a practical chemist in the whole Northwest; there are now fifty men employed in the Twin Cities.'

Certain sections of the country, beyond question, need awakening. The teacher should, and would, do great service by throwing out suggestions as to what and how it is done in other sections than the one in which he lives. Dr. J. Lawrence Smith said: 'We should do our full share in developing industrial chemistry,' and according to the address of one of our recent presidents: 'The pure and applied are interdependent and retro-stimulating.'

One of the defects noted by certain manufacturers in sections where chemists are appreciated is that oftentimes graduates have gone to them claiming a skill they did not possess. A student should have better preliminary preparation, more time in college and more inducements for graduate work. Financial aids offered students wishing to specialize in chemistry are more numerous and valuable now than in 1876. This assistance is secured in the form of appointments to fellowships, scholarships, etc., the emoluments, usually, for such services being from free tuition and laboratory fees to $600 per year.

Educational institutions still find it advantageous to import many chemicals and much apparatus. America produces heavy chemicals as pure and, considering the cost of transportation, etc., as cheap as the foreign manufacturers, but as yet little attempt is made by the American manufacturer to produce the finer organic preparations. This is due to several important factors, some concerned with legislation as, for instance, untaxed alcohol, tariff, patent laws, etc. The committee did not attempt to furnish statistics and information in regard to the chemical manufacturer, as one member of the committee (C. E. Munroe) is the Expert Special Agent of the Twelfth United States Census in charge of that subject, and is preparing a lengthy report which will be published in due time by the government.

Satisfactory machinery for all kinds of manufactures can be secured from domestic sources; it therefore appears that the heavier pieces, like iron ware, electrochemical apparatus, platinum ware, etc., are to be had economically in America. For the more delicate and stable glassware, however, it is quite necessary to import. Manufacturers have noticed the tendency to favor home-produced goods, and advertise thermometers, porcelain ware, etc., 'Made in the United States.' They deserve encouragement, but buyers are not inclined to pay too liberally for their patriotism.

While some very excellent American balances are made, the prices placed upon the same are high. It is claimed that American glass is inferior to German in quality and power of resistance to chemicals, and further there is much criticism of some dealers for substituting inferior goods. This is a clear business proposition, which offers an easy solution, but oftentimes serious inconvenience is caused by institutions and chemists located great distances from the distributing points. The most promising encouragement for instruments of accuracy in home-made goods is offered in the recent establishment of the National Standards Bureau, in the accomplishment of which members of the American Chemical Society took an active part.

A larger proportion of chemical students are turning their attention to pharmacy, a most desirable state of affairs. Progress is shown in that line by the many excellent and some bad preparations coming from the drug houses. It is unfortunate, however, that the examination boards of pharmacy in some states are too lax in their requirements for license.

Teaching of Chemistry in the Schools.—At the request of the Committee Mr. Rufus P. Williams, of the English High School, Boston, prepared a very instructive history of the teaching of chemistry in the schools, 1876 to 1901 (already published in SCIENCE). A careful study of the subject by student and teacher is urged. It is most important that they organize an association of science for chemistry teachers in various parts of the country, as has been done, with excellent results, by the New England teachers.

With very rare exceptions all institutions, offering courses in chemistry insist upon complementary laboratory instruction, which was not the case in 1876 (see Clarke's Report, Department of Education, 1880). Information from the smaller colleges, purely academic in character, shows that they now usually have a short required course in chemistry. In 1876 a meager course, usually of lectures, was required; now the subject is elective, accompanied with laboratory practice, in the larger institutions.

There is great room for improvement in the smaller colleges along two lines:

1. Employment of men especially trained to teach the subject. It is well known that men holding the degree of Master of Arts have been employed to teach in some of the small colleges, their work frequently being assigned to them after their arrival. This is an evil and an injustice to science, more widespread than is imagined, and one which can be corrected, and is being corrected, without financial loss to those institutions.

2. This may be illustrated by the statement of one teacher and needs no comment: "Most chemists in institutions like ——— college and other denominational schools are overburdened with other duties. For example, the undersigned has to teach algebra, geometry, trigonometry, analytic geometry, calculus, physics, botany, zoology, astronomy, physiology, manager of the college monthly, publications, etc., besides teach chemistry."

There are very few of the larger universities offering courses in advanced inorganic chemistry, such as are given at Cornell. Such work is offered as a rule rather under the head of research than in grouped lectures. Presentation of general chemistry to younger students is not now confined apparently to the old routine, but to an outline, based more upon the periodic system or the variations of it, so that the subject is exhibited more in detail and as a unit and in less time.

Within the past twenty-five years there has been a most gratifying progress in teaching medical students chemistry. Full appreciation of chemistry by doctors of medicine has not come about through such a vigorous reformation as advocated by Paracelsus. Bacteriological side-lights have illuminated the path. In addition to the usual lectures on chemistry, laboratory work is universally required and the best medical schools demand attendance on lectures on physiological chemistry, and personal experimentation with many of the products of animal metabolism. (See Vice-President Long's address before Section C, A. A. A. S., Denver Meeting, 1901.)

C. B.

MEMBERSHIP OF THE AMERICAN ASSOCIATION.

THE following have completed their membership in the American Association for the Advancement of Science during the month of April:

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SCIENTIFIC BOOKS.

Monographien aus der Geschichte der Chemie. Herausgegeben von George W. A. Kahlbaum. V. Heft. *Justus von Liebig und Christian Friedrich Schönbein. Briefwechsel 1853–1863.* Herausgegeben von George W. A. Kahlbaum und Ed. Thon. Leipzig, Johann Ambrosius Barth. 1900. 12mo. Pp. xxi+275.

In the summer of 1853 Schönbein paid a visit to Munich, and was introduced by von Pettenkofer to Justus von Liebig. Schönbein was at that time about fifty-four years of age and had won distinction by his discoveries of ozone, gun cotton and collodion; Liebig was three years his junior and his reputation was of the highest. The visitor from Switzerland was received by the resident of Munich most cordially, and to his great astonishment was invited to lecture to the students, at one of the regular hours used by Liebig, on his own studies and discoveries.

This friendly act was the beginning of an intimacy that found expression in the letters preserved in this volume.

Ozone naturally occupies much space in the letters written by Schönbein; in a letter dated September 30, 1853, Liebig objected to the name which was not adopted for a 'law of nature'; he also condemned the term allotropic. Several letters written in 1854 concern Schönbein's paper, 'Chemical Action of Electricity of Heat and of Light.'

In their letters the friends write of discoveries made by themselves and by other chemists, of theoretical views then under discussion, of their plans for travel and for lecturing, of their publications in periodicals, separates of which they forward to each other, as well as of purely personal and domestic matters, and but rarely of political questions. All the letters are given in full for reasons named by Dr. Kahlbaum in the preface.

About the year 1860 Schönbein wrote to Liebig of finding antozone in fluorite from Wölsendorf, and the Munich chemist replied that he had taken much pains to secure more of the mineral, but in vain; 'all the gold in the world' would not buy it, for no more could be found. In 1863 Liebig had the sad news to communicate of domestic affliction in the loss of a daughter, Frau Carrière. In this intimate way the friends exchanged words of sympathy, their hopes and fears, successes and discouragements, as well as their likes and dislikes.

The bibliographical and biographical notes added by the editor increase greatly the value of the interesting volume, which closes with a letter from Liebig to Schönbein's widow, dated September 8, 1868; in this he refers to his forty-six years of acquaintance with his Swiss friend whom he first met in student days at Erlangen.

HENRY CARRINGTON BOLTON.

Handbook for the Electrical Laboratory and Testing Room. By Dr. J. A. FLEMING. Vol. I., *Equipment, Resistance, Current, Potential, Power.* London, The Electrician Printing and Publishing Company; New York, D. Van Nostrand Co. 8vo. Pp. 538. $5.00.

Notwithstanding the shower of electrical books that has poured from the press for the past few years, comparatively few text-books have appeared which are well adapted for use in the American colleges of engineering. There has particularly existed a deficiency in the list of books available for the purposes of individual instruction and reference in the electrical laboratories. And a new book designed for this special purpose must be received with interest.

The widely and favorably known name of the author of the book before us adds to the interest in this volume, and an examination of the book shows that such an interest is justified. The volume (which the author proposes to supplement by a later one) contains five chapters, respectively setting forth the author's view of a proper laboratory equipment (190 pages), the measurement of electrical resistance (148 pages), the measurement of electrical current (82 pages), the measurement of electromotive force (48 pages) and the measurement of electric power (63 pages). It is proposed to complete the work—as announced in the preface—by a second volume devoted to the measurements of capacity, inductance, electric quantity, the magnetic testing of iron, photometry and the testing of electric lamps, the testing of electric batteries, electric meters, dynamos, motors and transformers. It is thus apparent that the book now in hand intentionally deals solely and somewhat abstractly with the measurement of the several fundamental electrical quantities which enter into various engineering tests, but a consideration of these tests is postponed until the later volume. We are therefore perhaps justified in assuming that this volume is intended for preliminary instruction in the laboratory where electrical engineering tests and measurements are actually executed in full. This assumption places a book of this character in its most favorable relation towards the instruction in American engineering colleges, and we will consider it from this point of view. No adequate book occupies this place, and a suitable one would be joyfully hailed by all teachers whose fortunes require them to direct college laboratories devoted to electrical engineering.

For text-book purposes, this volume, however, does not favorably appeal. More than thirty-five per cent. of the text is contained in the first chapter, which deals with the arrangement of electrical testing laboratories and the equipment which the author believes is desirable to have laid down therein. This is an interesting portion of the book, and contains much valuable suggestive matter. It may be read with profit by any teacher of electrical engineering. But college laboratories in this country are not well supplied with funds and they cannot afford (nor do they need) the elaborate ultimate standards for the recovery of the several electrical units which are here adverted to as desirable or even essential portions of a laboratory equipment. Neither do our manufacturers usually find it warrantable to carry their measurements to the refinement that this chapter implies is essential to reasonable laboratory practice. Such refinement is necessary and warrantable in only a few standardizing laboratories, or the laboratories maintained by the equally few manufacturers of fine electrical measuring instruments; and we therefore believe that the book in its present form is seriously misleading to students unless accompanied by extended oral explanatory lectures.

The second chapter of the book partakes of the character of the first. It contains much of interesting and valuable suggestion to the laboratory administrator and laboratory teacher, but little which commends it for use as a text-book with the average undergraduate laboratory classes. Neither can a large proportion of the methods, discussed in this chapter, serve a useful purpose in the daily work of a manufacturer's laboratory, unless he is a manufacturer of standard electrical measuring instruments.

The third and fourth chapters, which treat of the measurement of electrical currents and pressures, make closer contact with daily work in the electrical laboratory, whether it be of the college or the manufacturer. But even here are to be found various recommendations which are of doubtful value in commercial testing. For instance, the author, in harmony with methods of testing used by him some years ago, recommends the adoption of a small synchronous motor as a means for driving a contact maker when it is desired to delineate the current or pressure curves of an alternating current circuit. The author fails, however, to caution the reader that inevitable error is introduced into the forms of the delineated curves by the 'hunting' of the synchronous motor, unless the curves of motor counter-pressure and impressed pressure (line pressure) are nearly alike, or the motor construction contains special expedients to prevent appreciable hunting.

The author wisely gives much attention to the potentiometer as an instrument to be used for setting the pressure when calibrating voltmeters and for general use as an accurate, convenient and reasonably rapid device for measurement of electrical pressure. He curiously fails to note the universal sluggishness of hot wire voltmeters and ampèremeters which often causes their readings to be misleading when the quantity under measurement is subject to fluctuations—as, for instance, the current feeding a constant pressure arc lamp. The author wholly omits from consideration the ordinary two-coil frequency indicator for alternating current circuits. While this instrument does not read in absolute values, it is admirable as an indicator of the constancy with which frequency is maintained during a series of tests, and is far more useful in the average laboratory than either of the 'frequency tellers' described in the text.

The final chapter of the book, chapter 5, on the measurement of electrical power, is particularly disappointing. It fails to throw any light upon the difficult problem of measuring the power absorbed, in an alternating current circuit, by devices of low power-factor. The only expedient proposed by the author is one of little utility, if not of impracticability, under ordinary conditions. It also fails to deal adequately with power measurements, in alternating current circuits, when the currents and pressures are great. Wattmeters and their use are dealt with and described, but the admirable portable wattmeters made in this country by the Weston, General Electric and Whitney companies are not described or referred to. This indeed is characteristic of the book, and such excellent secondary standards as the so-called 'laboratory standard' ampèremeters and voltmeters of the Weston Company are given no attention. A noteworthy feature of the book, but one of doubtful merit, is the enthusiastic recommendation of instruments using mirror and scale. This recommendation extends to electrostatic voltmeters.

It may seem ungracious to farther criticize the details of an extensive and carefully written book which contains much that is admirable. It is a valuable book and every administrator of an electrical laboratory should own his copy and carefully ponder its words; but as a handbook for general use in the electrical engineering laboratory and amongst undergraduate college students in electrical engineering, it does not meet the American requirements.

The book is of fine 'get up' and is notably free from errors. The selection of references for short bibliographies which are scattered through the book, and the arrangement of tables at the end of each chapter, enlist favor for the author's judgment. But it seems doubtful wisdom, in a table showing the electromotive force of the Clark cell, to print the data to five significant figures (four decimals) when the values are confessedly not known with accuracy to four figures. Other tables are of similar character. For instance, on page 420, the electrochemical equivalents and data derived therefrom are given throughout to five significant places, though the original data depend upon ratios of atomic weights, many of which are not accurately known to three significant figures.

In reading the book one is impressed by its strong points, which are worthy of its author and in entire harmony with his reputation. But one leaves it seriously disappointed that the author, notwithstanding the promise of his preface, so signally fails to meet (at least as far as American practice is concerned) the special needs of the electrical engineering laboratories. We venture to hope that the second volume, which the author foreshadows in his preface, will more nearly meet those needs.

DUGALD C. JACKSON.

Die Vegetationsverhältnisse der Illyrischen Länder. Von Dr. GUNTHER BECK VON MANNAGETTA. Band IV. *Die Vegetation der Erde.* A. ENGLER and O. DRUDE. Leipzig, Wilhelm Engelmann. 1901. 8vo. Pp. xv, 533; 8 plates, 18 cuts and 2 colored maps.

The present work constitutes the fourth volume of the magnificent series of phytogeographical monographs founded by Engler and Drude. Like its predecessors, it is written by a lifelong student of the vegetation concerned. It differs from them chiefly in the nicer balance that is struck between floristics and ecology, showing how fully the author has kept abreast of the latest movements in phytogeography. The present volume is also unique in the series on account of the systematic treatment of formations, and especially on account of the consideration given the fungi and algæ. It not only maintains the high standard of the preceding volumes, but adds to it in these and other points.

The introduction treats of the history of the botanical investigation of Illyria, from the first recorded visit, that of Brasavolo (1500–55), to the present time. For a country with so few resident botanists, the number of botanical explorers is something remarkable. The thoroughness with which the flora and vegetation have been studied may be indicated in some degree by the fact that the bibliographical list, which contains very few general works, comprises nearly seven hundred titles contributed by more than two hundred workers, among whom Beck von Mannagetta, Borbás, Adamović, Ascherson, Baldacci, Farkás-Vukotinović, Fiala, Formanek, Freyn, Hirc, Kerner, Pančić, and Wettstein are prominent.

The entire work comprises four parts: I., 'A Sketch of the Physical Geography of the Illyrian Countries'; II., 'The Vegetation'; III., 'The Regional Floras and their Composition'; IV., 'The Relationship of the Flora to that of Adjacent Lands, and the Developmental History of the Flora since Tertiary Times.' The Illyrian lands comprise southern Croatia, the Quarnero Islands, Dalmatia, Bosnia, Hercegovina, Montenegro, northern Albania, Sandzak Novipazar and Servia, constituting a fairly natural region except on the south. The greater part lies in the drainage basin of the Danube; the western litoral, a relatively narrow strip, drains into the Adriatic. A peculiar hydrographic feature is found in the lost streams (Karstflüsse), which produce periodic swamps. Standing waters, lakes, etc., are not especially characteristic, being merely broadened stream beds, as a rule. The orographic and geological features of the country are considered somewhat briefly under coast formation, litoral, islands and mainland. The climate varies from subtropical along the Adriatic to boreal in the higher mountains. The summer months along the coast are very hot, and often entirely without precipitation. The total rainfall for this region is 90 cm. From October to December, the scirocco brings heavy rains. Frost and snow are rare. Further inland, the climate differs chiefly in its colder winters, greater precipitation, 140–190 cm., and in the fact that its prevailing wind, the bora, is a cold north wind. In the hill and mountain land, the summers are hot, but not dry. The winters are severe, the temperature often sinking to — 30° C. The precipitation varies from 70 cm. to 150 cm., much of which falls as snow during the winter. In the higher mountains, the snowfall begins in October, and the snow mantle persists from November to April. The total precipitation is 152–229 cm., the greater part falling as snow during December and January.

The plant formations of the Mediterranean region are grouped in the following series: thicket and forest formations, treeless formations and culture formations. The sole thicket formation is the evergreen 'Macchie,' a xerophytic, chaparral-like vegetation of the Dalmatian coast. In the formational list, the plants are grouped in two main divisions, upperwood (Oberholz) and undergrowth. The upperwood comprises evergreen trees with entire leaves, *Arbutus unedo, Myrtus italica* and *Viburnum tinus;* with pinnate leaves, *Pistacia;* and with acicular leaves, *Juniperus oxycedrus, J. phœnicea* and *Erica arborea;* a very few deciduous trees, *Coronilla* and *Ligustrum,* and such woody plants as *Ephedra* and *Spartium.* A number of evergreen and deciduous lianes are also found here, such as *Smilax, Rosa, Rubus, Clematis* and *Lonicera.* The species of the undergrowth are turf-builders, *Oryzopsis, Diplachne, Carex;* bulb and tuber plants, *Allium, Gladiolus, Orchis;* hapaxanthous herbs, *Trifolium, Linum, Arabis, Torilis, Helianthemum;* and pleiocyclics, *Genista, Teucrium, Silene, Anemone, Inula,* etc.

The cryptogams also receive more consideration than is usual. The principal mosses are *Weisia, Fissidens, Trichostoma, Bryum* and *Hypnum;* and the lichens, *Cladonia, Endocarpum* and *Psora.*

The strand pine formation, with a single facies, *Pinus halepensis,* is a characteristic open formation of the islands and of the immediate vicinity of the coast. The underwood (Unterholz) contains species of *Juniperus, Erica, Quercus, Pistacia, Myrtus, Laurus,* etc.; the undergrowth, *Dorycnium, Erythrœa, Allium, Genista* and *Brunella.* On the pine trunks occur *Frullania, Cladonia, Parmelia physodes, P. saxatilis, P. caperata, Lecanora subfusca, Lecidea parasema,* etc. On certain foothills of the Dalmatian mountains, the black pine formation (*Pinus nigra*) replaces the strand pine. The laurel formation (*Laurus nobilis*) occurs on the Dalmatian coast from Fiume to Castelnuovo, though examples of it are not frequent. The laurel is associated with *Quercus, Castanea, Ostrya,* and *Pistacia;* the underwood also is almost entirely deciduous, consisting of *Carpinus, Corylus, Ficus, Cotinus* and *Fraxinus.* The density of the foliage restricts the undergrowth mostly to a few ferns, except in the more open places. The litoral oak formation contains many facies, of which five are deciduous oaks, and one, *Quercus robur,* is evergreen. The underwood contains many evergreens of the macchie and pine formations, and about an equal number of deciduous trees and shrubs, *Carpinus, Cotinus, Cornus, Cratægus, Pyrus, Prunus* and *Rhamnus.* The undergrowth, which is not very well developed, is much the same as that of the other Mediterranean woody formations. The turf and herb formations of the coast region are the following: (1) the Dalmatian rockfield formation, with an extremely varied vegetation, consisting largely of *Salvia officinalis, Inula candida, Phlomis fruticosa, Helichrysum italicum, Marrubium, Euphorbia,* etc.; (2) the dune formation, comprising

Medicago marina, Eryngium maritimum, Echinophora spinosa, Polygonum maritimum, Agropyrum, Juncus, etc; (3) the strand cliff formation, *Crithmum, Lotus, Statice* and *Inula;* (4) the halophytic strand formation, *Atropis, Atriplex, Salicornia, Suæda, Salsola,* etc.; (5) the saltmarsh formation, *Juncus, Scirpus, Carex, Althæa* and *Tamarix;* (6) the strand meadow formation, and (7) the fresh-water swamps.

The forest formations of the interior are the following: (1) the oak-ash formation *Quercus, Fraxinus, Acer, Ulmus* and *Prunus,* a very widely distributed and extensive vegetation, with several closely related oak formations; (2) the formation of the black pine (*Pinus nigra*), resembling the Mediterranean formation in few points other than the single common facies; (3) the birch formation (*Betula alba*) found here and there throughout the interior; (4) the stream bank formation (*Alnus* and *Salix*); (5) the poplar formation (*Populus alba, P. nigra*) of the broad moist valleys. The only extensive thicket formation is of a mixed character, containing *Corylus, Juniperus, Populus, Carpinus, Acer, Cratægus, Fraxinus,* etc. The herbaceous formations of a closed character are the heath, the mountain meadow, the meadow, and the swamp meadow. The open formations are those of the rockfield, the sandbanks, and the swamps, pools and streams.

The vegetation of the mountain region is treated in exhaustive fashion. The tabular statement of the positions of the various formations in the different ranges, found from pages 287 to 304, cannot be too highly commended. In itself, it is a notable contribution, showing in graphic fashion the zonation and alternation of the mountain vegetation. The forests comprise the red beech formation (*Fagus silvatica*), the pine formations (*Pinus leucodermis, P. peuce*), the fir formation (*Picea omorica*), the spruce and fir formation (*Picea vulgaris, Abies alba*), and the mixed formation, containing *Picea, Abies, Pinus, Fagus, Acer, etc.* The subalpine thickets are composed largely of *Pinus mughus, Rhododendrum, Juniperus, Alnus, Salix* and *Fagus.* The herbaceous vegetation comprises the subalpine herb, the alpine mat, and the peralpine rockfield formations.

The marine vegetation is considered briefly under the headings, litoral region and sea region; no formational limitation is attempted. The special consideration of the floristic of the vegetation is found in the third and fourth parts. The two charts, one showing the distribution of the formations over the entire country and vertically on the mountains, the other the vegetation regions, are excellent, and are of the greatest service in gaining a knowledge of the general features of the vegetation. The whole book impresses one with its modernness and thoroughness. The author moreover has been exceptionally happy in picturing formations by description, a fact which has caused the lack of numerous illustrations to be much less noticeable. FREDERIC E. CLEMENTS.

THE UNIVERSITY OF NEBRASKA.

SOCIETIES AND ACADEMIES.

AMERICAN MATHEMATICAL SOCIETY.

A REGULAR meeting of the American Mathematical Society was held at Columbia University on Saturday, April 26. The President of the Society, Professor Eliakim Hastings Moore, occupied the chair, yielding it during the afternoon session to Professor Thomas S. Fiske. Thirty-seven members were in attendance at the two sessions. The Council announced the election of the following persons to membership in the Society: Professor C. E. Biklé, Columbia University; Professor F. W. Duke, Hollins Institute, Va.; Dr. J. G. Hardy, Williams College; Professor H. L. Hodgkins, Columbian University; Dr. J. N. Ivey, Tulane University; Dr. J. H. McDonald, University of California; Dr. H. C. Moreno, Stanford University; Dr. T. M. Putnam, University of California; Dr. E. W. Rettger, University of California; Mr. W. H. Roever, Harvard University; Professor Irving Stringham, University of California; Dr. S. D. Townley, University of California; Mr. H. E. Webb, Stevens School, Hoboken, N. J.; Mr. A. W. Whitney, University of California. Three applications for admission to membership were received.

The Council also authorized the organization of a Pacific Section of the Society, to hold meetings in the vicinity of San Francisco. The first meeting of the new Section has already been held, on Saturday, May 3, a program of sixteen papers having been provided for this occasion.

The following papers were read at the April meeting:

Dr. H. F. Stecker: 'The curve of least contour in the non-euclidean plane.'

Mr. J. L. Coolidge: 'Quadric surfaces in hyperbolic space.'

Dr. F. H. Safford: 'Dupin's cyclides of the third degree.'

Mr. Peter Field: 'On the forms of plane unicursal quintic curves.'

Miss R. G. Wood: 'Non-euclidean displacements and symmetry transformations.'

Mr. D. R. Curtiss: 'A note on the sufficient conditions for an analytic function.'

Miss I. M. Schottenfels: 'On the definitional functional properties for the analytical functions $(\sin \pi z)/\pi$, $(\cos \pi z)/\pi$, $(\tan \pi z)/\pi$.'

Professor C. A. Scott: 'On the circuits of plane curves.'

Dr. E. V. Huntington: 'A complete set of postulates for the theory of real numbers.'

Dr. L. P. Eisenhart: 'Surfaces whose lines of curvature in one system are represented on the sphere by great circles.'

Professor E. H. Moore: 'A definition of abstract groups.'

Dr. E. V. Huntington: 'A definition of abstract groups.'

Mr. L. D. Ames: 'Evaluation of slowly convergent series.'

Dr. Edward Kasner: 'Groups of Cremona transformations and systems of forms.'

Mr. A. D. Risteen: 'The constant of space.'

Dr. C. J. Keyser: 'Concerning the angles and the angular determination of planes in 4-space.'

Professor T. J. I'A. Bromwick: 'The infinitesimal generators of parameter groups,' and 'On the parabolas or paraboloids through the points common to two given conics or quadrics.'

The next meeting of the Society is the Summer Meeting, which will be held at Northwestern University, Evanston, Ill., in the first week of September.

F. N. Cole,
Secretary.

THE GEOLOGICAL SOCIETY OF WASHINGTON.

At the meeting of the Society on April 23, the first paper, 'Folded Faults in the Southern Appalachian,' by Mr. Arthur Keith, began with a statement of the typical Appalachian faults, which are characterized by great length and uniformity, high southeast dips, and anticlinal origin. Their planes are, for the most part, slips nearly parallel to the bedding. Next were described a group of faults whose derivation from anticlines is less obvious and whose planes are marked by great irregularity in direction and dip. Their irregularity can be ascribed to subsequent deformation, although the evidence of that is not always strong. These two classes of faults have been well known for ten or twelve years.

A third and most unusual class of faults comprises those in which great deformation by folding and faulting affected the fault planes after they were formed. This has given rise to extreme irregularity in direction and dip of the fault planes, and has thoroughly obscured their real nature. No trace of anticlinal origin appears and a section along a straight line will intersect a given fault in several places. A minimum measure of the throw is thus readily obtained and varies from fifteen to twenty miles. The evidence proving these faults consists in superposition of Archean granite on Cambrian sediments, discovery of fossils in some of the overlying masses, the establishment of a sequence of six or eight distinct formations, unconformities of distribution along the fault planes, and breccias and other direct evidences of faulting.

The position of the plane before folding can be reconstructed from the sequence of the formations against it in different places. There is thus developed a low dip of the plane toward the southeast in the nature of a shear plane gradually traversing the formations. Beginning on the northwest in the lower Silurian Tellico, it passes down through all the intervening formations into the Archean granite. From this general fact, in connection with numerous local details, it is inferred that the fault resulted from a direct thrust by the Archean granite. The deformation of the fault plane is as great as that produced in Appalachian strata generally by the great post-Carboniferous deformation. Thus the shear plane was formed before the principal epoch of Appalachian folding. Whether or not any interval ensued between the two it is difficult to say. Carboniferous rocks are involved in the shear plane, so that it was produced at least after the Carboniferous period.

Mr. J. S. Diller then gave a paper entitled 'The Copper Region of Northern California.' Mr. Diller stated that the copper region contains an extensive series of sedimentary rocks ranging from the Miocene into the Devonian, associated with igneous masses of various ages and kinds which have intercalated or intruded the sedimentaries. A number of mountain-building epochs are recorded by breaks already recognized in the stratigraphic and faunal succession, and others will doubtless be discovered in the detailed survey. The general abundance of fossils in the Cretaceous, Jurassic, Triassic, Carboniferous and Devonian sediments is such as to render it possible to work out the structure in detail.

The ore deposits of the copper region may be conveniently considered in three groups: Auriferous quartz veins, sulphides in contact zones, and sulphides in shear zones.

The copper industry has invigorated quartz mining in the region to furnish siliceous ores for smelting.

The Black Diamond Mine near Bayha shows a number of interesting ore bodies, chiefly pyrrhotite, chalcopyrite and magnetite associated with diopside, garnet and other minerals on the contact of diabase dikes cutting the carboniferous limestones.

The deposits of the Bully Hill and Iron Mountain districts occur along shear zones mainly within rhyolitic rocks. The ores of the Iron Mountain district are almost wholly pyrite and chalcopyrite, but in the Bully Hill district chalcocite is abundant with much barite and sphalerite.

Mr. Charles Butts presented a paper entitled 'Recent Structural Work in Western Pennsylvania.' He exhibited maps of the Masontown, Uniontown, Brownsville and Connellsville quadrangles with structure contours drawn on the base of the Pittsburg coal up to the western base of Chestnut Ridge, on the top of the Pottsville formation upon the ridge, and explained the methods by which the contours were determined. A brief description of structural details was then given. In general the rocks are folded into low ellipsoidal anticlines and shallow canoe-shaped synclines, which often show remarkable minor irregularities of structure and have a decided tendency to offset laterally at short intervals. The structure seems to be intermediate between the steep regular folding of the central Appalachian ridges and the low doming and pitting of the strata farther from the mountains, such as exists in western New York, where it is impossible to detect any linear arrangement of structures whatever.

A knowledge of the possibilities of such structures can not fail to be of great assistance in stratigraphic work in such regions and should diminish its perplexities while increasing the reliability of the results.

The last paper was on the 'Stratigraphy of the Big Horn Mountains,' by N. H. Darton. Mr. Darton gave a brief résumé of the principal stratigraphic features observed on the eastern flanks of the Big Horn Mountains during the summer of 1901. A detailed survey had been made of a portion of the district which is preliminary to more extended investigations. The geologic column comprises all the formations from Cambrian to Laramie excepting perhaps the Devonian and portions of the Silurian. Many fossils were found at various horizons, affording important means for correlation. A limited fauna was discovered in some thin limestones in the top of the Red beds but its age has not yet been definitely established. The column was compared with that of the Black Hills which had been studied in previous seasons, and a close general similarity is shown including the freshwater Jurassic but not including the Minnekahta (Purple) limestone. Conglomerates found in the Laramie formation indicate a pre-Laramie uplift of the central portion of the range.

Alfred H. Brooks,
Secretary.

DISCUSSION AND CORRESPONDENCE.

CAUSES OF THE SUDDEN DESTRUCTION OF LIFE IN THE MARTINIQUE VOLCANIC ERUPTION.

To the Editor of Science: During many years of teaching geology I have held in opposition to most text-books on the subject that explosive gases are evolved during violent volcanic eruptions and that the flames seen by eye witnesses do actually exist, independent of lightning and the glow of the hot lava reflected from the jet of steam, etc., which are usually given as the explanation of the appearance of flames.

My view has been that the heat is sufficient to cause the dissociation of hydrogen and oxygen from the water, on coming suddenly into contact with highly heated lava; and in case of sea-water the chlorine would also be dissociated from the sodium.

These gases suddenly ejected with great violence and exploding in the air, above the crater, would produce precisely the effects witnessed on an unusually large scale at Martinique.

The people were mostly killed by the sudden explosion of a vast volume of hydrogen and oxygen, which will account for the sudden burning of flesh and clothes, as well as of the buildings and vessels.

The chlorine, at the same time, combining with some of the hydrogen would produce hydrochloric acid, a poisonous and suffocating gas, which would quickly kill most of those not instantly destroyed by the explosion.

A. E. Verrill.

Yale University,
New Haven, Conn.,
May 14, 1902.

THE WHALE-SHARK (*Rhinodon typicus*) AS AN AMERICAN FISH.

To the Editor of Science: The notice by Mr. Barton A. Bean of "a rare 'whale-shark'" (Science, February 28, p. 353) is the first record of the *Rhinodon typicus* as a western Atlantic fish, but the species or an allied one has been several times noticed as a visitor to the Pacific coast of America. Mr. Bean has duly referred to my description of *Micristodus punctatus* in 1865. When I published that article I had serious misgivings lest the species would prove eventually to be congeneric with *Rhinodon typicus*, but the positive ascription to that form of simply conic teeth by such eminent authorities as Müller, Henle and others restrained me from identifying the California shark with it, and consequently I described the American form as the representative of a new genus and species. A comparison of the teeth of the California species with those of the Caribbean animal has led me now to consider them to be at least congeneric. The later notices of the dentition of individuals undoubtedly belonging to *Rhinodon* force on me also the conviction that all the selachians of like appearance are congeneric.

Mr. Bean, whom I had told that there was a considerable literature on *Rhinodon*, informs me that he has gone through the zoological and other records without finding any references other than the early one to *Rhinodon*. This absence of data is a striking illustration of how unsafe it is to conclude that because no references are found in the zoological records, no literature exists, and I now enumerate such articles as I happen to know about in which *Rhinodon* is mentioned.

Neglecting the general works in which *Rhinodon* (or *Rhineodon*) *typicus* has been described, we pass at once to the comparatively late notices.

In 1870 Professor E. Perceval Wright noticed its occurrence about the Seychelles Islands in a letter published in the 'Spicelegia Biologica' printed in Dublin. This I have not been able to consult as it is not in the libraries of Washington or Philadelphia.

According to Dr. Christian Lütken, however, Wright (p. 65) claimed that 'this shark, which is—the north whale excepted—the largest of living animals, * * * contrary to the general habits of the true sharks, is not a carnivorous but a herbivorous fish.'

In 1873, Dr. Lütken compared it with the basking shark, called by him *Selachus maximus*, in an article on the latter species in the 'Oversigt over det K. Danske Videnskabernes Selskab Forhandlinger * * * i Aaret' 1873 (pp. 47–66, pl. 2; résumé, pp. 8–10). A brief notice also appears in the 'Videnskabelige Meddelelser fra den naturhistoriske Forening i Kjöbenhavn,' for Aaret 1873 ('Oversigt,' p. 11). Dr. Lütken denies that the shark is herbivorous and maintains that it feeds on minute animals.

In 1874 Professor Wright described a crustacean parasite of the *Rhinodon* (*Stasiotes rhinodontis*) in an article 'On a New Genus and Species belonging to the Family Pandarina' in the *Proceedings of the Irish Academy* (pp. 583–585).

In 1876 Professor Wright incidentally treats of the *Rhinodon* in an article on 'The Basking Shark' in *Nature* (XIV., pp. 313, 314). He says "When engaged at the sperm whale fishery off St. Denis the fishermen often told me they dreaded to harpoon by mistake a *Rhinodon*. A whale must come up to breath or else choke itself. But there were stories told me of how a harpooned *Rhinodon*, having by a lightning-like dive exhausted the supply of rope, which had been accidentally fastened to the boat, dived deeper still, and so pulled pirogue and crew to the bottom—there, in spite of the harpoon in its neck and its attendant incumbrances, it was at home for a great length of time." (One would like to know the length of the rope and the depth of descent.)

In 1878, Professor W. Nation 'examined * * * a specimen captured at Callao. Of this specimen' the British Museum is said to possess "a portion of the dental plate. The teeth differ in no respect from those of the Seychelles chagrin [*Rhinodon typicus*]; they are conical, sharply pointed, recurved, with the base of attachment swollen." This notice is by Albert Günther in *Nature* (XXX., p. 365) and contains the first detailed account of the teeth, which had been previously described as simply conic.

In 1879, Professor Wright especially noticed the *Rhinodon* in his 'Animal Life.' (This work is not dated, a fault of the publishers, but it appears from the 'English Catalogue of Books' that it was published in 1879.) He repeats the information already given by him and postulates that the shark 'would appear to have a very limited geographical distribution.' If the animals elsewhere found are conspecific with it, however, the possible range is large.

In 1883, Mr. A. Haly, director of the Colombo Museum, records the 'Occurrence of *Rhinodon typicus* Smith on the west coast of Ceylon' in the *Annals and Magazine of Natural History* (5th ser., XII., pp. 48, 49). The specimen—a female—was 23 feet 9 inches long.

In 1884, Signor G. Chierchia, in a brief notice of the 'The Voyage of the Vettor Pisani,' an Italian corvette, in *Nature* (XXX., p. 365), alludes to a gigantic shark caught in the Gulf of Panama. The shark was called *Tintoreva* by the natives and the specimen was 8.90 meters (nearly thirty feet) long. Albert Günther adds a note identifying it with the *Rhinodon typicus* and expresses the opinion that the *Micristodus punctatus* is of the same species.

In 1884 Mr. Edgar Thurston, superintendent of the Madras Government Museum, records the capture of several specimens of *Rhinodon;* one '22 feet in length' which had been 'cast on shore at Madras in February, 1889,' and another '14 feet 6 inches in length was caught off Bambalapitiya (Ceylon)' in April, 1890. A photograph of the Madras specimen is reproduced in 'Bulletin No. 1' of the Madras Museum (Pl. III. A). A description is also interjected in a section of the report (pp. 36–38) on the 'Inspection of Ceylon Pearl Banks.'

In 1901 Kamakichi Kishinouye, of the Imperial Fisheries Bureau at Tokyo, published a notice of 'A Rare Shark, *Rhinodon pentalineatus* n. sp.,' in the *Zoologischer Anzeiger* for 1901 (XXIV., pp. 694, 695). It is not obvious how the species differs from *R. typicus*.

The question of specific differences (if any) within the genus must be reserved for a future occasion. Differences in the number of teeth and coloration may be of specific value.

Mr. Bean remarked that a specimen 'taken at the Seychelles Islands, is known from the teeth only' in the British Museum. That Museum has the fish itself, about 17 feet long, mounted by Gerrard. The only Museum specimen he knew of was the type in the Museum of the Jardin des Plantes. Besides that and the one in the British Museum, there are at least mounted specimens in the Ceylon Government Museum and the Madras Government Museum as well as, now, in the United States National Museum. The typical species is common about the Seychelles Islands. Dr. Bashford Dean informs me that it was also noticed during the voyage of the *Siboga*.

It is greatly to be deplored that the opportunity to obtain the skeleton and some of the soft parts of the Florida shark was not utilized for the National Museum. A rare opportunity was afforded by the waif of the Florida shore which is not likely to be repeated for a long time.

It may be added that *Rhineodon* was the first name applied to the genus and that possibly the American fishes may be specifically distinct from the type and entitled to the name *Rhineodon punctatus*.

Theo. Gill.

Cosmos Club,
Washington, April 28, 1902.

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A METEORIC IRON.

A meteoric iron which weighed a little less than nine pounds, and which as respects its shape and its surface markings seems to be almost unique, has recently come into the possession of the University of Wisconsin. The fall of this iron was not observed, but it was turned up by a plow in 1887 on a farm near Algoma post office, Kewaunee county, Wisconsin. Since that time and until March of the present year it had remained about the farm upon which it was brought to the light.

Instead of the usual lumpy form, this find has the shape of an elliptical shield, the major axis of which is about ten inches, the minor axis six inches, and the maximum (central) thickness about an inch. The smoothness and density of the convex surface is in sharp contrast with the irregularities and the crust of oxide upon the concave side. There is no reason to doubt that the projectile moved broadside on with the convex surface (Brustseite) to the front during its translation through the aerosphere. Upon this surface strongly marked radial lines are arranged like the rays of a solar plexus about a central, nearly flat elliptical boss some inches in diameter, and these lines increase steadily in depth as they approach the periphery. The Widmannstätten figures show no trace of deformation. Shortly after this find began to be studied by the writer a copy of Professor Cohen's paper on the flat meteoric iron from N'Goureyma in the Soudan (Griefswald, 1902) came into his hands. The two meteorites are in many respects similar, though the Algoma iron has the greater symmetry and much more perfect surface markings. It will shortly be more fully described.

W. H. Hobbs.

THE GEOLOGICAL SOCIETY OF AMERICA.

The fourteenth summer meeting of the Society will be held in Pittsburgh on Tuesday, July 1, in the room assigned to Section E, American Association for the Advancement of Science. The place now designated is the lecture room of the Oakland M. E. Church, very near the hotel headquarters. The Council will meet on Monday evening at the hotel. The Society will be called to order by the president, Professor N. H. Winchell, on Tuesday morning immediately following the general session of the Association.

The preliminary list of papers will be mailed about June 7. The Fellows are requested to send their titles and abstracts of papers upon the printed form as early as possible, and not later than June 3. By rule of the Council abstracts are required. Papers offered for printing in the *Bulletin* should be fully described on the blank forms, copies of which will be promptly sent on request.

The circular sent to the Fellows March 11, announced an excursion, under the guidance of Dr. I. C. White, through the Coal Measures of western Pennsylvania and northern West Virginia during the week preceding the Association meeting. The party will assemble at the Monongahela House on Monday evening, June 23. This hotel will be headquarters during the week of the excursion; the rate will be

$3 per day, American plan. Persons wishing to join this party should send their names to Dr. I. C. White, Morgantown, W. Va., without delay. During the Association meeting some shorter excursions are proposed, under the direction of Mr. James R. Macfarlane. When the details of the several excursions are perfected, a special circular relating to them will be issued.

The Hotel Schenley has been selected by the local committee, A. A. A. S., as the headquarters.

All persons attending the meetings in conjunction with the A. A. A. S. can secure the customary reduction in railway rates, to one and one third fare for the round trip, by obtaining a certificate at the starting point in the name of the Association. Tickets may be bought from June 19 to June 30.

HERMAN LE ROY FAIRCHILD,
Secretary.

ROCHESTER, N. Y.,
May 15, 1902.

SOCIAL AND ECONOMIC SCIENCE AT THE PITTSBURGH MEETING OF THE AMERICAN ASSOCIATION.

THE next meeting of the American Association for the Advancement of Science will be held at Pittsburgh from June 30 to July 3, 1902. The easily accessible location of the place of meeting, combined with its peculiar economic interest as a great industrial center, offers the opportunity to Section I for an exceptionally successful session. To make it such the hearty cooperation of all members of the Section is needed. They are cordially invited to attend the sessions and to contribute papers to the proceedings. They should inform the secretary as promptly as possible of the title and the probable length of any paper that they may care to present, so that notice of it may appear in the preliminary program.

CARROLL D. WRIGHT,
Chairman.
FRANK R. RUTTER,
Secretary.

DEPARTMENT OF AGRICULTURE,
WASHINGTON, May 2, 1902.

SHORTER ARTICLES.

STREPTOCOCCI CHARACTERISTIC OF SEWAGE AND SEWAGE-POLLUTED WATERS APPARENTLY NOT HITHERTO REPORTED IN AMERICA.*

DURING the last few years the brilliant researches of the bacteriologists connected with the Local Government Board of England have revealed two new organisms which, with the *Bacillus coli communis,* are likely to be of great service in tracing the history of water pollution. These are the *Bacillus enteritidis sporogenes* of Klein, and the sewage *Streptococcus* of Houston; so that now with three forms, all apparently characteristic of a sewage flora, the sanitary bacteriologist finds himself in a position to form a reliable opinion of the antecedents of any water submitted to him for examination.

The importance of the streptococci to the sanitarian was first pointed out by Dr. A. C. Houston in an article entitled, 'Bacterioscopic Examination of Drinking Water, with Particular Reference to the Relations of Streptococci and Staphylococci with Waters of this Class,' published in the Report of the Medical Officer to the Local Government Board for 1898–9 (Supplement, XXVIII. Ann. Rep., L. G. B.). He there stated that he had isolated both streptococci and staphylococci from polluted soils, from crude sewage, from sewage effluents and from impure waters; but he laid stress mainly upon organisms of the former class, as germs unlikely to persist for a long period outside the animal body, and therefore indicative of fresh pollution. He concluded by stating that the streptococci 'are organisms readily demonstrable in waters recently polluted and seemingly altogether absent from waters above suspicion of contamination. * * * Search for them should * * * constitute an important part of bacterioscopic analysis of potable waters.' In the report of the Medical Officer of the Local Government Board for 1899–1900 Dr. Houston extended his investigations to the study of a large number of additional samples of polluted waters and soils, with the result that the presence of the streptococci seemed always to coincide with

* Preliminary communication.

'animal pollution of extremely recent, and therefore specially dangerous, kind.' Professor W. H. Horrocks in his excellent 'Bacteriological Examination of Water' (London, 1901) devotes a short chapter to the importance of this group of microorganisms. In his own experiments he finds, just as Houston has done, that the streptococci are typical sewage forms, although he differs from that author as to their relation to strictly recent contamination.

Strangely enough these investigations appear thus far to have attracted little attention outside of England. Neither in America, nor on the continent, as far as we are aware, have the streptococci been reported as characteristic of sewage. Indeed Jordan in his classic report on the bacteria of sewage ('Special Report of the Mass. S. B. H. on the Purification of Sewage and Water, 1890') concluded that, 'a striking and highly remarkable circumstance is the comparative absence of micrococci, or spherical bacteria, from the sewage and effluents.' Probably his failure to detect these organisms may be explained by the fact that they grow slowly and uncertainly in media not containing sugars.

We first isolated the sewage streptococci of Houston in the spring of 1901, in a study of the bacteria occurring on the hands, chiefly of students and school children, where they were found in two out of some hundred specimens of wash-water examined—in both cases in conjunction with the *Bacillus coli*—but their importance was not recognized at this time. Later, we found the same organisms in Boston sewage and in fresh fæces where they appear often to be the most abundant forms present. They have also been isolated in considerable numbers from a septic tank by Mr. D. M. Belcher, a student working in the same laboratory as ourselves.

The occurrence of streptococci in polluted river water seems to be constant and significant. During March and April of 1902 we examined forty-eight different samples of water derived from the Charles River between Boston and Cambridge, the Mystic River between Charlestown and Everett, the North River at Salem and the Neponset River at Hyde Park. The examinations were made by inoculating dextrose-broth with one cubic centimeter of the water, plating in litmus-lactose agar twenty-four hours after, and studying the reactions of pure cultures obtained from the plates, in dextrose-broth, milk, nitrate solution, peptone and gelatin. As a rule the preliminary dextrose tubes contained, after twenty-four hours, practically a pure culture of some organism which had overgrown all other forms. In twenty-two of the forty-eight samples, the colonies on the litmus-lactose agar plates proved to be colon bacilli, or allied forms, and in one case a liquefier, resembling Jordan's *Bacillus cloacæ*. From the remaining twenty-five samples, cultures were obtained which gave all of the reactions of Houston's streptococcus as noted below, the growths on agar and gelatin and the rapid formation of acid from sugars being very characteristic. Stained preparations made from agar cultures showed short chains of streptococci mingled with irregular plate-like masses. In every sample of water examined, gas was formed in the preliminary dextrose tube, so that as the pure cultures later isolated on the lactose-agar plate gave no gas, it was evident that *Bacillus coli* or some other gas-forming organism must have multiplied at first and then have been overgrown.

Both Houston and Horrocks have published descriptions of a large number of streptococci isolated by them from sewage, designated by a complex series of letters and figures. It does not appear, however, that the differences recorded indicate anything more than slight variations from one main type. Most of the organisms described are streptococci, developing rapidly at 37°, growing rather better under anaerobic than aerobic conditions, producing a faint dotted growth of small, thin round colonies on agar, a beaded growth in the depth of the gelatin stab, and a strong acid reaction in milk. We have found a second type, apparently not noticed by the English observers, which has all of these characteristics, but liquefies gelatin, which the commoner streptococcus does not. Organisms of both types, as observed by us, fail to reduce nitrates or to form indol, and both produce acidity, but no gas, in the dextrose tube. The commoner, non-liquefying form appears to have been found by Laws and Andrewes in the sewage of St. Bartholomew's Hospital in 1894 (Report to the London County Council on the 'Micro-organisms of Sewage'). Still earlier Roscoe and Lunt ('Contributions to the Chemical Bacteriology of Sewage,' *Phil. Trans. Roy. Soc. London*, CLXXXII., 1891, not CLXXXIII., 1892, as given by Chester) described under the name *Streptococcus mirabilis* a form which developed best without air, gave faint growths on gelatin and agar, and formed a cottony mass at the bottom of the broth tube. These organisms are all closely related to each other, as well as to the *Streptococcus pyogenes* of Rosenbach; and until more detailed systematic study of the group is made, the common sewage forms may perhaps best be known provisionally as the 'sewage streptococci of Houston,' since he first called attention to their sanitary significance. We feel convinced that this group may prove of the greatest assistance to bacteriologists in this country, as it has done already in England, and that record of its presence or absence should be made in any sanitary bacteriological water analysis.

C.-E. A. WINSLOW.
(MISS) M. P. HUNNEWELL.
BIOLOGICAL LABORATORIES,
MASS. INSTITUTE OF TECHNOLOGY,
May 8, 1902.

*THE METRIC SYSTEM OF WEIGHTS AND MEASURES.**

THE Committee on Coinage, Weights, and Measures, to whom was referred the bill to adopt the weights and measures of the metric system as the standard weights and measures of the United States, having duly considered the same, respectfully report as follows:

By Section VIII. of Article I. of the Constitution power is vested in Congress to fix the standard of weights and measures, and yet, strange as it may appear, this is about the only great and important subject intrusted to its care by the express provisions of the Constitution which has been almost wholly neglected. Again and again has the necessity for a change in our system of weights and measures been urged upon the attention of Congress. Washington more than once pointed out the importance of securing a uniform system of weights and measures, and early in the history of our country the matter was referred to Jefferson, then Secretary of State, who proposed two plans, one an adaptation of the existing system and the other a strictly decimal system.

John Quincy Adams, as Secretary of State, after four years of careful study, made a report which is worthy of the attention of the most advanced thinkers upon this subject at the present day. He pointed out the failure of the English people to reduce to any sensible order the chaos of their weights and measures and urged upon Congress the necessity for a reform. He, however, advised delay until the metric or international system, which was then in its infancy, had been more fully tried, and to which he referred in a most glowing tribute as possessing all of the requisites of a simple, uniform, and workable system of weights and measures.

Since that time the adoption of the metric system has been repeatedly recommended by the departments of the Government and Congressional committees. The annual report of the Secretary of the Treasury for the year ending June 30, 1899, contains the following clear and concise statement:

* Report submitted by Mr. Southard, from the Committee on Coinage, Weights, and Measures, to the House of Representatives on April 21. The text of the bill recommended is as follows: *Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled*, That on and after the first day of January, nineteen hundred and four, all the departments of the Government of the United States, in the transaction of all business requiring the use of weight and measurement, except in completing the survey of public lands, shall employ and use only the weights and measures of the metric system; and on and after the first day of January, nineteen hundred and seven, the weights and measures of the metric system shall be the legal standard weights and measures of and in the United States.

The intense commercial rivalry of nations warns us to leave nothing undone which might further our own interests, and there can be no doubt that the introduction of the metric system, to which this country stands pledged since the meeting of the International American Conference in 1890, would greatly facilitate international commercial transactions. Without doubt Great Britain and Russia would follow the initiative of this country in this matter, and thus, what a few decades ago would have been considered an unattainable ideal, namely, a system of weights and measures common at least to all western nations, would be reached.

It is not the purpose of this recommendation to place before Congress a full discussion of this subject. The various committees appointed by it from time to time to consider this matter have made exhaustive reports covering aspects of the question no less important than the commercial one—reports always agreeing on the necessity for reform, always considering our present system a temporary one and out of harmony with our decimal notation and monetary system, and since 1866 always recommending the introduction of the metric system.

The great difficulties which seemed to stand in the way appear to have been over-rated, for its introduction into Germany, Austria, and other European countries was accomplished with little or no confusion. This Government, therefore, would not enter upon an untried experiment if its obligatory introduction in all governmental affairs was ordained, as it has been in the countries named.

The subject of a reform of our system of weights and measures engaged the attention of Washington, Jefferson, Madison, and Adams, and in Congress the reports of Messrs. John A. Kasson in 1866, Alexander H. Stephens in 1879, and Charles W. Stone in 1896 and 1898 advocated the introduction of the metric system.

Among my predecessors, Robert J. Walker, in 1847, urged it upon Congress, Secretary Chase gave it his support and Secretaries Windom and Foster successively concurred in the favorable recommendation of Secretary of State Blaine. Secretary Carlisle adopted as fundamental standards for the Treasury Department the metric standards prepared at the International Bureau of Weights and Measures, an establishment maintained by the principal nations of the world. The various States of the Union were, by the action of Congress in 1866, supplied with copies of the principal metric standards.

All these facts exhibit a consistent endeavor on the part of the executive as well as the legislative branches of our Government, from its foundation to the present time, to reform our heterogeneous metrology.

As the present time seems most opportune and the matter of great importance, it is recommended that Congress take such action as will bring about the desired end.

The delegates of the United States to the Pan-American Congress were instructed in 1889, by the Secretary of State, as follows:

1. That the desirability of promoting the establishment of an international system of weights and measures be recognized as a principle of action in legislation.

2. That the decimal or metric system shall serve as the basis of unification.

3. That all nations, not already parties to the convention signed at Paris, May 20, 1875, establishing an International Bureau of Weights and Measures, shall become parties thereto.

4. That the aggregate statistics of international commerce shall be, where it is not yet being done, published also in metric equivalents.

5. That all invoices shall be made out in metric weights and measures, where weights and measures appear, as far as they relate to the commerce between the nations participating in this congress, and that the table of equivalents herewith shall be recognized as legal by the nations taking part in this congress, in converting the customary weights and measures of the United States into metric weights and measures in making such invoices.

6. That metric weights be used exclusively in the mints.

These are but a few of the recommendations that have been made by the officers of the Government and others in authority from the beginning of the Republic to the present time. To these must be added the efforts of many of the best men of the country in all lines and professions, scientific societies, commercial and manufacturing organizations, who have striven to bring order out of chaos, and who have recognized the value and importance of a suitable system of weights and measures to every interest of the country. While these efforts have met with practically the unanimous approval of all who have given the subject any attention whatever, the failure of these efforts to bring about the adoption of a better system of weights and measures has been due to the willingness with which many would rather endure a present evil than submit to a temporary inconvenience for the benefit of the present and future generations.

THE WEIGHTS AND MEASURES IN COMMON USE.

A complete list of the weights and measures in common use would be difficult to make and would involve much space. The various units have been inherited from a time when exact measurements were unheard of, computations were seldom made, and when each locality and different interest had its own system of measures. Modifications and adjustments have been made from time to time; nevertheless it is still full of inconsistent ratios, difficult to learn and still more difficult to remember. The units are not related to each other; many units of the same name have entirely different values. It is unsuitable for computation, and is not decimal in character. The advantages to be gained by the adoption of the metric system as compared with the one in present use are far greater than the benefits derived from the adoption of a decimal system of coinage in place of the English monetary system.

It is a popular fallacy that our weights and measures are in accord with those of Great Britain, but this is not true, as neither our pound, yard, gallon, or bushel is identical with the corresponding English unit.

Very few people are familiar with the weights and measures in common use in the United States. One has but to recall the tables of our three different systems of weights, the apothecary, troy, and avoirdupois, to illustrate this fact. And while the yard may be stated as our standard of length, we find in practice various arbitrary multiples of the yard and foot; for example, the fathom, the surveyor's and engineer's chains and links, the nautical and statute miles, hands, poles, perches, and various others. In addition to the ordinary cubic measure, we find three systems of measuring capacity, dry measure, liquid measure, and apothecary's fluid measure. To these might be added a large number of technical standards in use in the various trades and industries in common use which would be greatly simplified and unified upon the adoption of the international system of weights and measures. An examination of the tables of our weights and measures discloses the fact that there are sixty-four different ratios used, of which nineteen are not divisible by 2, and that there are eighteen terms used which have two or more meanings. Certainly any effort to replace this conglomerate system with a simple, logical one, similar to our monetary system, is worthy of the consideration of Congress.

THE METRIC OR INTERNATIONAL SYSTEM.

The metric system of weights and measures was devised as an international system. The fact that it was first adopted by France has given rise to the custom of referring to it as the French system. It is interesting to note, however, that one of the first to propose a decimal system of weights and measures was James Watt, the inventor of the steam engine. The adoption of a decimal system of coinage by the United States was one of the strongest influences leading to the adoption of the metric system by France. The unit of length in the metric system is called the 'meter' and was defined as the one ten-millionth part of the distance from the equator to the pole of the earth measured on a meridian. The first of these units to be constructed was by the French Government, and was based on the best known measurement of the earth's surface at that time.

An international congress was held in Paris in 1875 for the purpose of improving the standards. Accordingly a number of meters were constructed of the best material and by the best methods known to science. One of these was selected as the international standard of length and is very carefully preserved at the international bureau of weights and measures established and maintained by the countries participating in the congress and those which have joined the convention since. These meters were very carefully compared with the one selected as the international standard and then distributed to the countries interested. The unit of mass or weight, as it is commonly called, is the 'kilogram,' and is defined as the mass of a cubic decimeter of pure water at a standard temperature. The international committee also prepared forty pieces of metal equal in mass to that of the cubic decimeter of water, alike in form and of the same material as the standard meter, the most permanent metal known. One of these was retained at the International Bureau of Weights and Measures as the international kilogram.

The same precautions were observed in the comparisons with each other and with the one selected as the international standard before distributing them to the respective governments. Of the two meters and two kilograms sent to the United States one of each is preserved as the national standard of length and mass. The others are taken as working standards, and serve as the basis of all comparisons of length or mass in this country. The fact that the meter is only approximately a natural standard as originally intended has sometimes been used as an objection to the metric system. This, however, is of little importance, since the meter and the kilogram as constructed are as permanent as it is possible to make material standards and are far more accurate than any measurements that can be made of the earth's surface. If at any time a suitable natural standard should be discovered, the meter would simply be defined in terms of that standard as it originally was in terms of the earth's quadrant.

The advantages of the metric system may be briefly stated as its decimal character throughout, the simple relations between the units making it possible to derive all others directly from the unit of length, its elasticity (being equally convenient for the measurement of the smallest or largest objects), the ease with which it is learned and remembered, the saving of time, and the increased accuracy with which computations may be made. These advantages have been proven by a century of use, but that which especially commends it to us at the present time is its international character, since it is the opinion of all who are in a position to know that the world must soon come to an international system of weights and measures, and that there is not the slightest possibility of our own system or any modification of it becoming universal.

THE METRIC SYSTEM AS USED IN SCIENTIFIC WORK.

Scientific investigators early recognized in the metric system of weights and measures a simple, flexible system equally suitable for the most refined or coarsest measurements, or for purposes of computation. As a result the scientific world to-day enjoys the advantages of a universal system of weights and measures, a fact which has greatly facilitated the development and spread of scientific knowledge. The practical applications of scientific work have in many cases been seriously handicapped or retarded owing to the necessity of converting formulæ derived in the metric system to equivalent formulæ in the common system. If the formulæ and other data used in manufacturing and engineering were universally expressed in the metric system, it would greatly promote the growth and dissemination of such knowledge throughout the entire world.

BENEFITS TO BE DERIVED BY EDUCATIONAL INTERESTS.

The benefits to be derived from the adoption of the metric system by the educational interests of the country are perhaps the most important that have been brought to the attention of this committee. Estimates made by the Department of Education and others show that the work of at least two thirds of a year in the life of every child would be saved by the adoption of the metric arithmetic. The British Parliamentary committee having in charge a similar investigation estimated the saving of time at one year. This is a matter the importance of which can hardly be overestimated, taking into consideration the large amount of work to be covered in the curriculum of the schools and the enormous sums annually devoted to educational work. The metric system is taught in nearly every school in the country. Teachers and pupils alike unanimously testify as to the ease with which the system is taught and learned and the facility with which it is applied to the problems which in ordinary arithmetic are complex and difficult to solve. When we consider that there are over 15,000,000 school children in the United States being educated at a public cost of not less than $200,000,000 per year, the enormity of the waste will be appreciated. In the lifetime of a single generation nearly $1,000,000,000 and 40,000,000 school years are consumed in teaching a system which is in harmony with that of no other nation of the world.

In higher education the metric system of weights and measures is used almost exclusively, and attention is called to the action of the associated academic principals of the State of New York—a body of some 700 high school principals, superintendents and prominent educators—which has passed the following resolution in regard to the adoption of the metric system:

Resolved, That we hereby instruct our legislative committee to forward to Congress of the United States, if there shall be suitable occasion and opportunity, our earnest petition for the enactment of such legislation as shall render the use of the metric system obligatory throughout the United States.

Many similar actions by educational bodies of all kinds throughout the country have been called to our attention.

It is a matter of evidence on the part of educators in the United States, Great Britain, and Continental Europe that the metric system and its application to the solution of problems may be learned in one tenth the time required for gaining an equal facility in the use of the English system of weights and measures. It is doubtful whether any measure of more vital importance and benefit to the educational interests of the country has ever come before Congress.

RELATIONS TO MANUFACTURING INTERESTS.

It should be emphasized that this measure in no way contemplates any change in existing technical standards, such as screw threads, wire gauges, lumber measures, and numerous others, except as manufacturers and other interests involved find it to their interest to make the change. Doubtless a change in the fundamental standards of length and mass would facilitate the simplification of such standards; but the changes would still be brought about as heretofore by the special interests involved.

Any change in the standards employed in manufacturing, no matter how perfect the systems proposed or how beneficial the change may be, must be very carefully and judiciously made. In the case of textile fabrics, materials of construction, package goods, and almost all kinds of manufactured products, a change would no doubt involve some inconvenience, but the expense of modifying existing plants or machinery would be very slight. In many cases no change or expense would be necessary, and the benefits to be derived from a convenient and universal standard would far more than compensate for the expense and confusion temporarily involved during the transition stage.

The relation between the manufacture and the sale of these products is so close that any change in the system of weights and measures which will lessen the burden and expense of the counting room and office is worth the cost, considered from the standpoint of economy alone. The action of many associations of manufacturers and merchants, both in the United States and in Great Britain, has been called to our attention, and without exception they have urged the adoption of the metric system of weights and measures, on account of its international character and superiority over the present system for manufacturing and commercial purposes.

In no other country has the construction of machinery reached a degree of perfection superior to that of our own, a result principally due to the system of interchangeable parts. The latter may be said to be a product of American ingenuity and to be the greatest single advance in modern machinery. It has for its essential features a uniform standard of length and accurate length-measuring instruments. This work has been done upon the basis of the inch, which in many cases has been decimalized.

There are a few who claim that the inch is better suited for this purpose than the units of the metric system. However, it should be kept in mind that the interchangeable system does not depend upon the unit used, but upon uniform, reliable standards and accurate measurements, and it is difficult to see why the inch and fractions of an inch should be superior to the centimeter and decimals of a centimeter. German, French, English, and American manufacturers are successfully manufacturing upon a metric basis and have shown no desire to return to the old system, notwithstanding the fact that the change has been made in the latter cases under very adverse circumstances.

It is admitted that the temporary inconvenience caused in the shop and drafting room by the proposed change would be very serious if suddenly brought about, but any measure which contemplates only the gradual introduction of the one system for the other, or even the continuation of the old by all except the departments of the Government in case it is desired, can not be said to be compulsory or capable of producing more than a minimum of inconvenience or expense, and certainly an interchangeable system upon an international basis will be superior to one based on the standard of a single country.

THE NECESSITY FOR THE METRIC SYSTEM IN COMMERCE.

The enormous development of the commerce of the United States within recent years has brought to the attention of our merchants and business men the great advantages to be derived from the adoption of an international system of weights and measures. The use of the old system not only involves great loss of time in making computations, but places our merchants at a great disadvantage in dealing with countries which have already adopted the international system.

More than sixty per cent. of our commerce is now carried on with countries using the weights and measures of the metric system, and it is evident that the commerce of the world must soon conform to the metric basis.

Theodore C. Search, president of the National Manufacturers' Association of the United States, states as follows:

Wherever manufacturers undertake to extend their trade in foreign countries, they encounter the metric system, and it is the only system of absolute uniformity which prevails throughout the world. The pound, the quart, the gallon, the ton have varying values, wherever encountered in foreign countries, and to insure accuracy the use of these units requires further explanation and some qualifying description in order to indicate just what quantity is meant. The enormous growth of our export trade during the past four years has brought our manufacturers in touch with the outer world as never before, and has given very practical illustration of the cumbersome character of our methods of measurement, and the advantages to be derived from the adoption of a system which is absolute and uniform throughout the world. * * *

And as we have only just entered upon a commercial conquest of the world, the utility of the metric system will become more and more apparent and the necessity for its adoption more urgent with each year of our growing export trade. The extension of our governmental functions to the Philippines, Cuba and Porto Rico brings into the circle of our commercial operations millions of people to whom the metric system is the recognized standard and to whom our own cumbersome system of weights and measures is a strange and unknown language of trade.

We recognize that any effort to supplant our present system of weights and measures with the metric system will be attended with more or less difficulty, and will involve some trouble for many of our manufacturers, because of the necessity of changing drawings, patterns, and standards, but we believe it entirely possible to accomplish such a change by gradual steps, and there should be no necessity for causing loss or injury to any of our industrial interests.

It seems to me that every argument is in favor of the unification of standards of weights and measurements throughout the world, and for us to insist upon an adherence to our antiquated standards is not in accord with the progressive nature of our people and the progressive tendency of this age.

Mr. W. O. Wilson, director of the Philadelphia Commercial Museum, states as his belief that 'millions of dollars are lost every year in transporting our weights, measures, and money from that of one country to another in our international business relations.'

The testimony of Mr. Godfrey L. Cabot, a prominent merchant of Boston, includes the following statement:

> Wherever this great improvement has gone, it has simplified the ordinary commercial transactions of daily life, minimized disputes, and given an absolute standard from which there could be no appeal and in which there was the least possible danger of error or misunderstanding.

RELATION OF THE METRIC SYSTEM TO TRADE.

The necessity for an improvement in the weights and measures of the country is nowhere more apparent than in the ordinary business transactions of daily life. Grain and produce are bought and sold by capacity measure, the bushel, peck and quart. The necessity for handling these commodities in large quantities by weight has resulted in the adoption of different weights for a bushel for the same commodity in different parts of the Union, and in a few of the Western states the hundredweight is used instead of the bushel. The diversity in this respect is so great that a correct table of the number of pounds to the bushel of different commodities for the several states is difficult to procure.

The long, short, and gross tons, without any distinction in name, are used in the buying, selling, and transportation of coal, ore, metals, and other heavy products. For liquids in large quantity the barrel used has many different values, and we find in common use often side by side avoirdupois weights, troy weights, apothecary weights, and the weights of the metric system. To add to this confusion the subdivisions of the ordinary measures are often not adhered to. The engineer uses the foot and tenths of a foot instead of feet and inches; the manufacturer, inches and decimals of an inch instead of adhering to the binary division; the gauger uses gallons and tenths of a gallon. In the handling of bullion we find troy ounces and thousandths of an ounce instead of ounces and grains. The engineer has discarded the inch, while some manufacturers of machinery have discarded the foot, hence we find tenths of a foot and the inch in common use. These are but a few of the instances where the introduction of the metric system would not only afford the advantages of a decimal system but furnish a system sufficiently elastic for all purposes. The experience of other nations has shown that the confusion and inconvenience caused by a change in the measures used in daily life was largely overestimated, and in no case have the people expressed a desire to return to the former system of weights and measures.

CONCLUSION.

The countless transactions involving the use of weights and measures make any proposition involving a change a most important one. The decimalization of our own system of weights and measures has been proposed by a few who have failed to consider the importance of an international system and the utter impossibility of the rest of the world adopting such a system as our own, however it may be improved in form. A change of this sort would be incomparably more radical than the adoption of the metric system. It has also been proposed to modify the existing system to one having a base of eight or twelve on account of the possibility of continued binary subdivision, but here again not only is the importance of an international system overlooked, but the impracticable idea is proposed of combining such a system with a decimal system of numbers. When the base of our system of numbers is changed to some other than ten it will be sufficient time to talk about a system of weights and measures having the same base.

It should also be kept in mind that the metric system is just as capable of a binary subdivision as any other, although the advantages of such a division are only apparent in the most ordinary business transactions, and for the first few subdivisions. After the adoption of the metric system, the use of the half and quarter meter and half and quarter kilogram would be as common as our half and quarter dollar—smaller quantities would be expressed in decimals precisely the same as in the case of our money.

In 1866 Congress legalized the metric system. From that time on it has been growing in favor and in practical use. It is here to stay, not only in scientific work, but in commerce and manufacturing. It is now used by about two thirds of the people of the world. Russia, Great Britain and the United States are the only nonmetric countries. Russia has gone so far in the direction of its adoption that it may well be excluded from the list, leaving Great Britain and the United States. In both of these it has been legal for some time. Indications are that Great Britain will soon join the list of metric countries. Over 300 members of Parliament have already signified their willingness to vote to make the use of the metric system compulsory.

Your committee believe the time has come for the gradual retirement of our confusing, illogical, irrational system and the substitution of something better. The first step in this direction should be the introduction of the metric weights and measures into the departments of the Government. The use of these weights and measures will simplify their work. It will familiarize the people with them and encourage their application to the common affairs of life. Your committee have no doubt that the benefits to be derived will far more than compensate for such inconvenience and expense as may be involved in the change.

Your committee have amended said House bill 123 in line 4 by striking out the word 'three' and inserting in lieu thereof the word 'four'; also in line 9 by striking out the word 'four' and inserting the word 'seven.'

As thus amended your committee earnestly recommend the passage of the bill.

NATIONAL GEOGRAPHIC SOCIETY NOTES.

President A. Graham Bell has appointed General A. W. Greely Chairman of the Committee on the eighth International Geographical Congress which will meet in Washington in 1904 under the auspices of the National Geographic Society. General Greely was the delegate of the Society and also of the United States Government to the Geographical Congress which met in Berlin in 1899 and also to the Congress that met in London in 1895.

Dr. Israel C. Russell, Professor of Geography in the University of Michigan, has been elected a member of the Board of Managers of the National Geographic Society. Professor Russell is one of the three members of the expedition sent by the National Geographic Society to Martinique and St. Vincent.

The corner stone of the Hubbard Memorial Building which will be the home of the National Geographic Society in Washington was laid on April 26 by Melville Bell Grosvenor, the great-grandson of the late Hon. Gardiner Greene Hubbard, the first president of the Society. It is hoped that the building which is being erected at a cost of $60,000 will be ready for the Society by January 1, 1903.

The National Geographic Society has decided to act as trustee for Mr. Borchgrevink for his proposed American expedition to the South Pole. Mr. Borchgrevink proposes to start in the summer of 1903 and will leave the scientific direction to the National Geographic Society.

At a recent meeting the National Geographic Society has instituted a change in its By-Laws and created a body to be known as 'fellows.' 'Fellows' of the Society will be limited to those persons who are actively engaged in geographic work.

EXPEDITION TO MARTINIQUE.

The National Geographic Society has sent on the *Dixie* three geographers to make a special study of the recent volcanic eruptions. The Society has chosen three of its members, Professor Robert T. Hill, of the U. S. Geological Survey, Professor Israel C. Russell, of Ann Arbor, Michigan, and C. E. Borchgrevink, the noted Antartic explorer, to proceed to the scene of the disturbance to make a careful examination of conditions there.

Professor Robert T. Hill is acknowledged as the foremost authority on the West Indies in this country. He has written many scientific reports and books on Cuba and Porto Rico; has visited Martinique and St. Vincent, and for a long time has predicted the present eruption. Professor Israel C. Russell, head of the department of geography in the University of Michigan, is the author of the book on 'Volcanoes of North America,' the standard work on the subject. Mr. Borchgrevink, when in the South Polar regions, examined the volcanoes Erebus and Terror, the most southern known volcanoes on the globe. He made a careful study of volcanic conditions in the far south, which will enable him to compare volcanic conditions of the far south with those in the center of the globe.

The three scientists go as the representatives of the National Geographic Society by whom their expenses are paid. On their return they will make a special report to the Society which will be published in the journal of the society, *The National Geographic Magazine.*

The importance of this expedition of the National Geographic Society cannot be too highly appreciated. The United States Government has no funds to send a scientific expedition to foreign territory. It is most important that eruptions which have taken place and are now going on should be studied at the earliest possible moment. A scientific investigation of Mount Pelée on Martinque and La Soufrière on St. Vincent and conditions of the neighboring islands will greatly enhance our knowledge of what is going on in the earth below the surface. The sooner the investigation is started the more comprehensive will be the results.

SCIENTIFIC NOTES AND NEWS.

THE Council of the Royal Society has recommended for election to membership the following fifteen candidates: Mr. H. Brereton Baker, Professor Henry T. Bovey, Professor Rubert Boyce, Mr. John Brown, Mr. William Bate Hardy, Mr. Alfred Harker, Mr. Sidney S. Hough, Mr. Robert Kidston, Mr. Thomas Mather, Mr. John Henry Michell, Mr. Hugh Frank Newall, Professor William M. Flinders Petrie, Mr. William Jackson Pope, Mr. Edward Saunders and Dr. Arthur Willey.

PROFESSOR C. S. MINOT, of the Harvard Medical School, has been granted leave of absence and will spend part of the year abroad. He will, however, give the presidential address at the Pittsburgh meeting of the American Association for the Advancement of Science, and will return for the meetings of scientific societies during Convocation week.

THE Hon. James Wilson, Secretary of Agriculture, and Dr. B. F. Galloway, chief of the Bureau of Plant Industry, will receive the degree of LL.D. at the Missouri State University at the June commencement.

DR. W. H. METZLER, head of the department of mathematics in Syracuse University, has recently been elected a Fellow of the Royal Society of Canada, and a Fellow of the Royal Society of Edinburgh.

THE gold medal of the London Linnean Society has been awarded to Professor Rudolf Albert von Kölliker, of Würzburg.

DR. J. E. DUERDEN, of Johns Hopkins University, will take the place, for the coming year, of Professor H. V. Wilson, at the University of North Carolina. Professor Wilson has leave of absence and will spend the year abroad.

MAJOR RONALD ROSS, F.R.S., has been appointed the head of a new department of the Jenner Institute of Preventive Medicine, London. The department is to be devoted to the systematic study of the animal parasites.

THE Lawes Agricultural Trust Committee has appointed Mr. A. D. Hall, principal of the Agricultural College, Wye, to succeed the late Sir Henry Gilbert, F.R.S., as director of the Rothamsted Experimental Station.

PROFESSOR GEORGE E. BEYER, professor of entomology at Tulane University, Dr. Oliver L. Pothier, of the New Orleans Charity Hospital, and Dr. Parker, of the Marine Hospital service, have gone to Vera Cruz, where they will make an inquiry into the relation of the mosquito to yellow fever.

DR. T. A. JAGGAR, of Harvard University, and Dr. E. O. Hovey, of the American Museum of Natural History have proceeded to the seat of the volcanic disturbances at St. Pierre for geological investigation.

MR. PERRY O. SIMONS, for the past three years engaged in the collection of scientific specimens in Chile and other South American countries for the British Museum, has been murdered by a native guide.

Mr. William Jolliffe, a well-known civil engineer, has died at Roanoke, Va.

Senhor Augusto Severo, the Brazilian aeronaut, was killed, with his assistant, while making a trial trip in his air-ship on May 12.

Mr. J. V. Mansel-Pleydel, the author of several works on the fauna and flora of Dorset, died on May 2, aged eighty-four years. The death is also announced of Mr. John Glover, the inventor of improved methods in the manufacture of sulphuric acid.

Nature says: The death of Professor H. von Pechmann, in sad circumstances, on April 24, is a great loss to the science of chemistry in Germany. He had been ill for a long time past, suffering, it would appear, from an incurable nervous trouble and frequent attacks of mental depression. That he might be restored to health he was granted a long leave of absence, and on resuming his duties was seemingly better than he had been for some time. But soon after his return he again became depressed and, while in that state, put an end to his life by taking strong sulphuric acid in his laboratory. Professor von Pechmann was only fifty-two years of age, having been born in 1850, and the University of Tübingen will feel his loss very keenly. Appointed to the chair of chemistry at the last-mentioned university in 1895 in succession to Professor Lothar Meyer, his skill in teaching and his personal charm were such that the number of students under him increased very considerably and, as a consequence, the enlargement of his laboratory and lecture-theater was regarded as necessary. The late professor was a native of Nüremberg, and descended from an old Bavarian family of great social influence.

According to an official statement recently issued the endowment of the Nobel Foundation is about $7,500,000, and the value of each of the five prizes to be awarded at the close of the present year will be nearly $40,000.

A civil service examination will be held on June 10 for the position of forestry inspector in the Philippines. It is expected that there will be four appointments at a salary of $1,800 and two at a salary of $1,200.

The final appraisement of the estate of the late Jacob S. Rogers shows a value of $6,063,173. After deducing the costs of administration and the legacies it is estimated that the residuary estate which will go to the Metropolitan Museum of Art under the will is $5,547,922.60.

Mr. Julius Wernher has contributed £1,500 toward an endowment fund for the Institute of Mining and Metallurgy, London.

The Senate has passed the bill authorizing the Commissioner of Fish and Fisheries to establish a biological station on the Great Lakes at some appropriate point in New York, Pennsylvania, Ohio, Michigan, Indiana, Illinois, Wisconsin, or Minnesota to be selected by him. For the purpose of conducting an investigation as to the most suitable site for such station, and for acquiring by lease, purchase, or otherwise the necessary land and water rights for the erection of such buildings, wharves, and other structures as may in future be necessary for the proper equipment of the station, $10,000 is appropriated.

The twenty-seventh annual meeting of the American Academy of Medicine will convene at Saratoga, on June 7, and continue during Monday, June 9. The officers of the Academy are: *President,* Dr. V. C. Vaughan, Ann Arbor, Mich.; *Secretary,* Dr. Charles McIntire, Easton.

The thirty-third meeting of the Eastern Association of Physics Teachers will be held in Boston, at the Massachusetts Institute of Technology, on May 24, at 2 p.m. The subject of the discussion is 'The Correlation of Manual Training in Physics,' opened by President G. Stanley Hall, of Clark University, who will be followed by Mr. J. M. Jameson, Pratt Institute, Brooklyn, N. Y.; Mr. C. B. Howe, High School, Hartford, Conn.; Mr. C. W. Parmenter, Mechanic Arts High School, Boston, Mass.; Mr. C. F. Warner, Mechanic Arts High School, Springfield, Mass.; Mr. C. R. Allen, High School, New Bedford, Mass.; and Mr. F. M. Gilley, High School, Chelsea, Mass.

At the annual meeting of the Institution of Civil Engineers, London, Mr. Charles Hawksley, president, in the chair, the result of the ballot for the election of officers was declared as follows: President, Mr. J. C. Hawkshaw, M.A.; Vice-Presidents, Sir William White, K.C.B., Mr. F. W. Webb, Sir Guilford Molesworth, K.C.I.E., and Sir Alexander Binnie. The council have made the following awards for papers read and discussed before the institution during the past session: A Telford gold medal to Mr. W. M. Mordey, and a George Stephenson gold medal to Mr. B. M. Jenkin, M.Inst.C.E., a Watt gold medal to Mr. J. A. F. Aspinall, M.Inst.C.E., and Telford premiums to Messrs. W. C. Copperthwaite, A. H. Haigh, B.Sc., and J. Davis, M.Inst.C.E. The council have also awarded the Howard quinquennial prize of the institution to Mr. R. A. Hadfield, M.Inst.C.E. (of Sheffield), for his scientific work in investigating methods of treatment and new alloys of steel and on account of the importance in industry of some of the new products introduced by him.

THE forty-fifth meeting of the American Society of Mechanical Engineers will be held in Huntington Hall, Boston, from May 27 to 30 inclusive.

AN extra meeting of the American Institute of Electrical Engineers will be held on Wednesday, May 28, at 8:15 P.M., at the house of the American Society of Civil Engineers, New York City. It will be devoted to the general subject of electricity in the army and navy.

THE seventh annual congress of the Southeastern Union of Scientific Societies, as we learn from *Nature,* will be held at Canterbury on June 5–7. On Thursday, June 5, the president-elect, Dr. Jonathan Hutchinson, F.R.S., will deliver the annual address. The following papers will be read during the meeting: 'The Marine Aquarium, without Circulation or Change of Water,' by Mr. Sibert Saunders; 'Recent Researches on Mimicry in Insects,' by Professor E. B. Poulton, F.R.S.; 'The Preservation of our Indigenous Flora, its Necessity, and the Means of accomplishing it,' by Professor G. S. Boulger and Mr. E. A. Martin; 'Borings in the Neighborhood of Canterbury,' by Mr. W. Whitaker, F.R.S.; 'Mycorhiza, the Root Fungus,' by Miss Annie Lorrain Smith. There will be an excursion to the Southeastern Agricultural College, Wye, by the kind invitation of the principal, Professor A. D. Hall, who will explain the valuable experimental work now being carried on in connection with the college.

A CONVERSAZIONE of the British Institution of Electrical Engineers will be held in the Natural History Museum, South Kensington, on Tuesday, July 1.

The British Medical Journal reports that Dr. Verneau, president of the Anthropological Society of Paris, has examined four sets of human remains discovered in the grottos near Mentone during the researches lately ordered by the Prince of Monaco. They are stated to have belonged to the quaternary period, and they were found at no great distance from the surface. The skeletons are small, and the skulls are described as strongly developed, and of the dolichocephalic type. There were large nasal orifices. The race they represent is believed to have had low-pointed features. The arms were long and distinctly negroid. The summary of the examination so far by Dr. Verneau seems to favor the idea that these human remains belonged to creatures holding a place between the baboons and negroes.

A REPORT on the brake tests by the Automobile Club on May 1 has been published. The action of seventeen different types of automobile, of a victoria drawn by horses, a four-in-hand coach and a bicycle ridden by an expert, a member of the police bicycle squad, was compared. The results were as follows, speed and distance covered in stop being taken:

Vehicle.	Speed.	Distance.	
Automobile	8 to 9 m. per hr.	9	feet, average.
Victoria	ditto	17	"
Four-in-hand	ditto	26	"
Bicycle	ditto	8	"
Automobiles	15 miles	29	feet.
Victoria	ditto	37	"
Four-in-Hand	ditto	77½	"
Automobiles	20 miles	53	feet.
Four-in-hand	ditto	91	"
Bicycle	ditto	61½	"

About ninety runs were made, the course being laid out on the Riverside Drive. The technical committee of the club reports that the impression produced was that eight miles an hour is a very slow pace and that the evidence that the automobile can be stopped much more quickly than any other vehicle and can be manœuvred with much greater ease and convenience is positive and ample. They are said to be a much safer conveyance than the horse-drawn vehicle.

Reuter's agency has received despatches announcing the safe arrival on March 23, at Gildessa, on the Abyssinia frontier, of Mr. W. Fitshugh Whitehouse, Jr., the American explorer, and Lord Hindlip. The explorers left England at the beginning of the year with the intention of making a journey from Zeila to the Upper Nile. When the despatches were written, the travelers were in good health and had been able to secure ample camel and other transport. At Jibuti they were joined by Dr. Victor Bell. The party expected to reach the Abyssinian capital, and after making a stay with Colonel Harrington, the British agent, proposed to resume the journey either *via* the Sobat or the Blue Nile. On leaving Adis Abeba it was Mr. Whitehouse's intention to spend a month in the 'devil-infested' region of Walamo in order to investigate the cause of the native belief that the country is possessed by demons.

UNIVERSITY AND EDUCATIONAL NEWS.

Over $800,000 have been subscribed towards the endowment fund of $1,000,000 for the Johns Hopkins University. This fund will be used to support and enlarge the work of the University, not for the construction of buildings on the new site as has been stated in some of the newspapers.

Bryn Mawr College has secured $200,000 toward the $250,000 needed to meet the conditional gift of $250,000 from Mr. John D. Rockefeller.

President Wheeler, of the University of California, has announced that gifts aggregating $80,000 have been made to the University. One of the largest is that of D. O. Mills, of New York, who gives $50,000 to be added to the fund of $100,000 given by him twenty-one years ago for the establishment of the Mills professorship of moral philosophy and civil polity.

Dartmouth College has received $32,500 from the estate of the late F. W. Daniels of Winchester, Mass. Mr. Daniels was a member of the class of 1868.

Mr. Francis E. Loomis has established a fellowship in physics at Yale University, open to graduates of the academical department, and the Sheffield Scientific School.

An institution has been established at Milan by M. Ferdinand Bocconi with an endowment of $200,000 to give scientific training for commercial work.

The regular work of the Gordon Memorial College at Khartoum in the Soudan will be started next year. It will be remembered that on the initiative of Lord Kitchener about $1,600,000 was subscribed in memory of General Gordon.

Professor Frederic S. Lee will next year offer a course in physiology to students of Columbia College, the work in physiology having hitherto been confined to the Medical School. Mrs. Lee has given $500 toward equipping the laboratory.

Professor S. W. Williston, now of the University of Kansas, has been elected head professor of paleontology at the University of Chicago.

Dr. Herman Schlundt has recently been elected instructor in physical chemistry at the University of Missouri. Dr. Schlundt took his degree at the University of Wisconsin last June. At Missouri he will have sole charge of the work in physical chemistry.

Dr. Joseph Swain, president of Indiana University and formerly professor of mathematics there and at Stanford University, has been offered the presidency of Swarthmore College.

Lord Roseberry has been elected chancellor of the University of London, in succession to the late Earl of Kimberley.

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, MAY 30, 1902.

CONTENTS:

SCIENTIFIC RESEARCH.*

IN connection with the so-called form of initiation as prescribed by the constitution of this Society we find this precept, 'The president or his deputy shall explain the aims and objects of the society.'

I understand it to be a common interpretation of this provision that a more or less formal address is to be presented, either by the president of the chapter, or what in the present case at least would be better, by some distinguished member of the society acting as deputy, to retain the phraseology of the written law.

In connection with the exercises of this evening the duty appears to fall upon my shoulders, but it is not my purpose to make this communication either lengthy or formidable.

As to the aims and objects of this society we find them fully set forth in section 2 of the Constitution viz.:

> The object of this Society shall be to encourage original investigation in science, pure and applied: by meeting for the discussion of scientific subjects; by the publication of such scientific matter as may be deemed desirable; by establishing fraternal relations among investigators in the scientific centers and by granting the privilege of membership to such students as have, during their college course, given special promise of future achievement.

* Address delivered at the initiation of new members of the University of Pennsylvania Chapter of the Society of Sigma Xi, April 18, 1902.

It is then with science, pure and applied, that we have to deal as distinguished from those departments of study, called by their votaries the humanities. These are defined as 'the branches of polite or elegant learning, as languages, rhetoric, poetry and the ancient classics.'

Now we shall have no quarrel with these pursuits or with those devoted to them, unless it be with the assumption that they are essentially the polite and elegant branches of learning as distinguished from the pursuits of science, and that the latter must be relegated to a lower plane. We accept no second place for science either from the standpoint of its importance to the welfare of the human race, or as a means of culture in a system of education.

No doubt it would greatly benefit many or all of us if we could spare more time from our pressing duties for the enjoyment of poetry, of literature and the fine arts, but we are also persuaded that very many of those who find their vocation in these fields would find great advantages in a more intimate acquaintance with physics, chemistry and biology.

The object of our Society, as above stated, is to encourage original investigation in science, pure and applied. What then is science and what constitutes original investigation? The term science is much abused by many who appropriate it. Ever since the days of St. Paul, and doubtless for a much longer period the human race has had with it innumerable forms of science falsely so-called. It is as important to-day and for ourselves as it was for Timothy nearly 2,000 years ago, that we should avoid what Paul called the vain babblings of this description of science.

When, however, we examine critically the meaning of this term we find it to be one which may be employed to designate all departments of human knowledge. 'Scire,' to know, is the root from which it springs. We understand it to apply, however, only to such departments of knowledge as have been formulated and classified with reference to general laws, and it is the attempt to discover such laws, underlying and connecting the phenomena which we see about us that constitutes scientific investigation. Whenever all of the observed facts of any science, as astronomy or chemistry or biology, can be so fully understood as to admit of expression in a strictly mathematical form, this science may be considered complete. It is perhaps unnecessary to add that we possess no such completed science, nor is there any promise that we ever shall.

The term science then embraces a great number of departments of knowledge and deals with truth in almost every form, so soon as we have the means of assuring ourselves that foundation principles are indeed truth and not fiction. Thus we have psychology, theology, economics, sociology, mathematics, the entire range of physical and biological sciences, and many other departments of mental activity which may be regarded as possessing claims, more or less admissible, to be included within this honored body.

When we refer to the object of this Society as expressed by its founders—to encourage original investigation in science—we might perhaps infer that we were taking all knowledge as our province. This, however, is not our purpose. The science with which we are now concerned is understood to be limited to the mathematical and physical branches.

This limitation is emphasized by reference to the history of the Society. I quote from the report of a committee appointed in 1893 to consider some matters related to the policy to be pursued.

The Society was established in 1886 by a few earnest workers in the engineering sciences, as a means of rallying and encouraging those qualities which were deemed of the first importance in their own lines of investigation. It soon became broadened and enlarged to represent the general ideals of highest scholarship in the minds and before the ambitions of every earnest student in any branch of science. It proposed to recognize and elect to its membership those men in our institutions of learning who should exhibit in a marked degree the qualifications of natural endowment and training required for successfully conducting original research in various branches of science.

Then among the conditions which must be met in order to qualify an institution for the establishment of a Chapter we find this:

That the number of distinct branches of science represented by full professors in the institution shall be at least five; and these branches should include mathematics, physics, chemistry, biology (some department of it) and engineering (some department of it).

This Society then has for its object the encouragement of original investigation in science. But what constitutes original investigation, and how is it to be carried on? Probably all of us have known earnest students of science in some of its forms, men or women it may be who by reading and study have acquired a great fund of information, but who have no more idea of any way in which they can add anything to the existing store than has a new-born babe.

Some have regretted their misfortune in being born too late. If they could have appeared on the scene before Shakespeare had exhausted the field of dramatic literature, or Newton and Laplace that of universal gravitation, or Columbus that of geographical discovery, they could have done these things, and thereby have achieved immortal fame.

On the other hand as an illustration of the true scientific investigator let us consider the example of Mr. S. W. Burnham, of Chicago. Mr. Burnham is the leading authority of the world in the astronomy of double and multiple stars. His profession is that of a stenographer, astronomy or physics occupying no prominent place in his early training. Forty years ago, as many other men have done before and since, Mr. Burnham purchased for his entertainment and instruction a cheap telescope of five inches aperture. This was soon afterwards replaced by a slightly larger one, which in turn gave way in 1869 or thereabouts to a six-inch glass by the celebrated Alvan Clarke. This modest instrument Mr. Burnham pronounces simply perfect in performance.

The thousands of double stars which are scattered in every part of the heavens had an especial fascination for this amateur astronomer. To quote his own words:

My attention for some reason or other which I am unable to explain, had been almost exclusively directed to double stars previous to this while using the smaller telescope referred to. This preference was not in any sense a matter of judgment as to the most desirable or profitable department of astronomical work, or the result of any special deliberation upon the subject. It came about naturally without any effort or direction on my part.

A little building in the rear of Mr. Burnham's residence sheltered his telescope from the elements, and here he found his pleasure after the work of the day was over in scanning the heavens, identifying and measuring the systems which had been found by the Herschels and the Struves, and in gathering up hundreds of pairs which had been overlooked by his predecessors. During all the early years of his activity in this field, he was actuated only by the satisfaction which he was deriving and probably never suspected that it involved anything remarkable. It is hardly an exaggeration to say that he awoke one morning to find himself famous.

Contrast this brief account with the history of another aspirant for glory in this same field, Sir James South, of England.

In 1842 the late Professor O. M. Mitchel visited Europe for the purpose of inspecting foreign observatories, and purchasing a telescope for the proposed Cincinnati Observatory. In the interest of this object he visited most of the leading European astronomers, and among others, Sir James South. This was during or about the time of a long litigation, which grew out of a contract between this astronomer and a firm of instrument makers who undertook to mount equatorially a large object-glass belonging to South. Mitchel describes his interview as follows:

One apartment was examined after another, until finally we reached a large room surmounted by a dome of great size and expensive construction, while fragments of the framework for mounting a great equatorial were scattered about. "Here," exclaimed Sir James, "you behold the wreck of all my hopes. Here I have expended thousands and flattered myself that I was soon to possess the finest instrument in Europe, but it is all over, and there's an end."

I remarked that the object-glass was still in his possession and might yet be mounted, so as to realize his hopes and expectations.

"No," said Sir James, "Struve has reaped the golden harvest among the double stars and there is little now for me to hope or expect."

It would be difficult to appreciate the feelings which at that moment were sweeping through the mind of the astronomer. Long cherished visions of fame and high distinction, or perhaps of grand discoveries in the heavens which for years had played round his hopes of the future, had fled forever. Another had reaped the golden harvest, and like Clairault who wept that there was not for him, as for Newton, the problem of the universe to solve, Sir James South could almost weep to think that another's eye had been permitted to sweep over the far distant realms of space, which he had long hoped might remain his own peculiar province.

Yet this very field which Struve was supposed to have exhausted is precisely where Burnham was winning his laurels a quarter of a century later. As to its exhaustion we have the best of authority in Burnham's own words. He says:

The late L. W. Webb, author of 'Celestial Objects for Common Telescopes,' one of the most eminent English amateur astronomers, in a letter written to me in 1873, after the publication of my first three catalogues said: "It will hardly be possible for you to go on for any great length of time as you have begun because the number of such objects is not interminable, and every fresh discovery is one less to be made." Since that time more than 1,000 new double stars have been added to my own catalogue, and the prospect of future discoveries is as promising and encouraging as when the first star was found with the six-inch telescope.

It seems strange when we think of the thousands of years during which the human race has inhabited this planet, that so long a period elapsed before anything which could properly be called scientific inquiry manifested itself.

One of the first problems to present itself was the greatest of all and may be said to include all others, viz., the problem of the universe itself; the origin, structure and end of the world on which we live and of the attendant bodies as the sun, moon and stars were supposed to be. Naturally the first attempts at solution were what may be called theological. One such with which we are all familiar forms the opening paragraph of the book of Genesis, 'In the beginning God created the heavens and the earth.' As humble inquirers after knowledge I have no doubt we may accept this account without the slightest hesitation, but this helps us very little in our quest for scientific truth. Neither the heavens nor the earth nor anything therein is the result of a supreme act of creative power exerted once and for all, but rather of an unfolding or evolution from a former condition in accordance with the unchanging laws of nature.

Suppose by the way of fixing our ideas that we were able to trace backward the history of our earth from its present status to that of a highly heated self-luminous globe, before life in any form had made its appearance, or carrying our history farther into the past to a time when this earth with the sun and all of the planets were united in a single mass of nebulous matter filling and extending far beyond the orbit of Neptune. Have we now reached the beginning spoken of, or shall we push our investigation farther into the remote past, to account for the existence and characteristics of this nebulous matter which constitutes raw material out of which suns and worlds are formed?

After a long and active struggle which even now perhaps is hardly ended, it has come to be understood that scientific research and theological views cover entirely different ground and that any conflict between the two is purely of man's invention. It is now more than 250 years since Galileo was compelled to renounce the heretical doctrine which placed the sun and not the earth at the center of the planetary system. But little more than one tenth of that time has passed since a distinguished geologist, himself an active Methodist, is said to have been compelled to sever his connection with a so-called university for holding the view that this planet had been occupied by the human race for a longer period than 6,000 years.

It was the Greek philosophers who first attempted by reason and research to solve the physical problems with which we as a society are concerned. Many of these were men of remarkably keen intelligence and the measure of their success marked the highest level reached in these directions for 1,500 years or more. Until the somewhat indefinite period known as the renaissance, almost the only science known, at least in Europe, was that of the Greeks. No one can deny that humanity is deeply indebted to them for this heritage. Regarded however as a solution of the problem in view, the efforts of the Greek philosophers were one and all a sad failure. Their effort was nothing less than to find an answer to that ancient and insoluble riddle, the problem of the universe; their method, the utterly fruitless one for this purpose, that of deduction. They hoped to find a great, general, all-embracing principle, and by pure reason to evolve from it everything which exists. Thus Thalis regarded water as the origin of all things, another ascribes this place of honor to air, and another to fire. It is true that Aristotle and others insist upon the importance of observing and classifying the facts of nature, and studying in this way the fundamental laws connecting and governing them, but how effectually or ineffectually this was done may be shown by one simple example, viz., the law of falling bodies as enunciated by Aristotle himself. This he states to be that bodies descend more quickly in proportion as they are heavier. It seems almost incredible that a statement, the falsity of which is so easily proved, should have been made by Aristotle in the first place, and in the second place should have been accepted apparently without question for 2,000 years. I know of no example drawn from the history of science which impresses me more forcibly with the propensity of the average human being persistently to close his eyes to those things going on around him, and to refer to the authority of another for an account of that which it would seem he could hardly avoid seeing for himself. In the present case it was only necessary to drop two stones of unequal weight from a house top to prove the statement erroneous, but if any one took upon himself the small amount of trouble this implied, before Galileo utilized for the purpose the leaning tower of Pisa, history is silent on the subject.

Perhaps the most ambitious attempt ever made towards evolving a universal science was that of Descartes. This philosopher boldly asserted that he should consider it of small importance to show how the universe is constructed, unless he could show that it could not have been constructed in any other way. His method was that which had been so often tried and found wanting as an instrument for the study of nature—

that of deduction. Time is wanting for an examination of the details of this ambitious scheme, nor is it necessary to say that in its main purpose it proved a lamentable failure. Nevertheless the Cartesian philosophy enjoyed great popularity on the continent of Europe for many years, where it blocked the way to the acceptance of the true doctrine of gravity as developed by Newton. It is a disputed point whether this system was more of a help or a hindrance in furthering the cause of truth.

It seems a little strange perhaps that a mind so acute as that of Descartes, whose possessor made such important contributions to pure mathematics, should not have perceived, as did his contemporary, Bacon, that the truths of nature can only be learned by the study of nature, by a patient and careful attention to details, discarding at once the notion that our feeble powers can by any possibility attain to a comprehension of the entire scheme of the universe.

As an illustration of the process by which the sciences having to do with the material things of nature are developed let me invite your attention to that one with which I am more familiar than with any other, astronomy.

There is no people or tribe so rude or so low in the scale of intelligence as not to be familiar with some of the fundamental truths of astronomy. In fact we may almost say that the lower animals possess some astronomical knowledge. But a familiarity with the diurnal and annual motions of the sun, the changes of the moon, and even the ability to recognize at sight every star visible to the eye, to assign its proper place in the constellation to which it belongs and to tell at what season of the year it is visible, all this comes far short of constituting a science of astronomy. These phenomena and many others had occupied the attention of the Chaldeans and Egyptians for hundreds of years, but these people never had anything which could properly be called a science of astronomy. Nevertheless the records of eclipses and other phenomena preserved by these students of the heavens were of very great service to the true founder of the science, Hipparchus, about 150 B.C. The first step toward the founding of any science is the same in character. A working hypothesis must be devised which will connect together in the best manner possible the detached facts of observation. It is here that a judicious use of the scientific imagination is called for.

If the choice of a hypothesis is a happy one it may prove to be the first approximation to the true law of which we are in search. It is to be adhered to so long as we can represent by it in a satisfactory manner all of the facts of observation, and the moment when it is found to conflict with observation it must be modified or abandoned. The investigator who sets himself to work looking for facts to sustain a favorite theory is pretty likely to succeed to his own satisfaction, but he is not the man who contributes greatly towards increasing the world's store of scientific knowledge.

But to return to Hipparchus. His system is well known. The earth was the center of the universe; the mechanism of the celestial motions was a combination of circles; by properly proportioning the parts of the machine the celestial motions could be represented with as high a degree of accuracy as they could be observed with the primitive instruments of those days. Eclipses and other celestial phenomena could be predicted, and the thoroughness with which the work was done is attested by the fact that this system answered all requirements for a period of more than 1,500 years. Yet we know that what we may call the two fundamental hypotheses of Hipparchus were erroneous—placing the earth at the center, and assuming the motions to be uniform and circular. As to the first of these we must admit that with the evidence then attainable it was the most plausible. In fact as regards the stars we are now, or were until quite recent times, in very much the condition which confronted Hipparchus in considering the earth and sun. We know that many of the stars have proper motions, as they are called. In reference to any individual star the appearance would be the same whether we ascribed this motion to the star itself or to our system. The true condition of things is one of the problems which is engaging the attention of the astronomers of to-day.

As to the attempt to represent the planetary motions by combinations of circles, this is precisely what we are constantly doing when we expand the expressions entering into our planetary theories in terms of sines and cosines.

A time came when the primitive system of Hipparchus could no longer be made to harmonize with the results of observation. It was therefore destined to give way to another which may be considered as a second approximation—that of Copernicus, as perfected by the labors of Kepler. Here the sun is the center of planetary motion; the orbits are ellipses with the sun in one of the foci, but the fundamental cause of these motions, the law of gravity, and the modifications produced by the mutual perturbations are as yet unrecognized. No place is found for those apparently erratic bodies called comets.

The next great advance is due to the labors of Newton; by referring all to the law of universal gravitation he was able to explain not only the elliptic motions, but the departures from these curves produced by the mutual perturbations of the planets. At the same time it was shown that the comets which heretofore had been regarded with suspicion as erratic visitors, were in fact orderly, law-abiding members of the system like the planets themselves.

Is this then a final solution? Is the law of gravity as enunciated by Newton to be regarded as rigorously true, or does it merely form another approximation to the truth? Apparently we may consider it as absolutely true, though from time to time doubts have arisen on this point. The perturbations of Jupiter and Saturn, the secular acceleration of the moon's motion, the behavior of Encke's comet and the motion of Mercury's perihelion have at one time or another given rise to difficulties some of which have never been completely overcome.

But whether or not the law is rigorously true, no progress whatever has been made toward its physical explanation. In spite of all the ingenuity which has been exercised in this direction it remains as much a mystery as in the days of Newton. The true physical explanation is one of the great problems whose solution is still in the future.

In this development we have noticed a few names which stand out in bold relief. Hipparchus, Copernicus, Kepler, Newton. Are these the only ones to whom credit is due for the creation and development of this department of science? By no means; the astronomer who accumulated observations, the mathematician who helped to perfect the methods of research, and the student of mechanics all contributed to this end and are all entitled to a share in the glory of victory. As has been said: If the Greeks had not studied conic sections Kepler could not have superseded Hipparchus; if the Greeks had studied mechanics Kepler might have anticipated Newton.

Doubtless many branches of science which will occupy the attention of future investigators are still unborn. The status of many of the younger members of this family resembles that of the astronomy of Hipparchus. Detached facts have been collected, hypotheses have in many cases been formed as to their relations and the laws governing them. In reference to any one of them the near or remote future may produce a Newton to demonstrate the fundamental law by a rigorous mathematical analysis. Meanwhile any laborer in the particular field who has the patience or skill to make an observation or an analysis or perhaps a contribution to pure mathematics may be entitled to his share in the triumph. Though the amount contributed be small there is a great satisfaction in feeling that your labors have been the means of adding something to the world's store of knowledge.

Mankind is no longer striving to evolve a universal science, or an all-embracing system of philosophy. We now recognize the fact that the same frontier which bounds our knowledge bounds also our ignorance, and as the area of the known increases, in the same ratio do the points of contact with the unknown. Every problem solved calls into being new ones for future struggles, and whether or not the universe is infinite, it is at all events for our purposes inexhaustible, so there is no lack of employment for all who may have the ambition to enter the field.

This society is especially designed to further the cause of science in the colleges and universities. As I understand the matter its most important function is that of offering encouragement and recognition to those who are about entering the arena of active life. We make no distinction between pure and applied science. Our purpose is to strive for the advancement of knowledge and the conquest of nature. The earnest student of truth will find his highest reward in the satisfaction which attends the discovery and recognition of the fundamental laws of nature and the essential unity of all, with the consciousness that he has contributed something, however small the amount, towards a proper understanding of her mysteries.

C. L. Doolittle.
University of Pennsylvania.

THE IMPORTANCE OF A LABORATORY COURSE OF PHYSICS IN THE STUDY OF MEDICINE.*

Many medical colleges include in their teaching a course of physics, consisting of lectures illustrated by experimental demonstrations of important principles. Few give a laboratory course in which qualitative and quantitative experiments are made by the students themselves. In order to ascertain approximately how many medical colleges in the United State give laboratory courses of physics, letters were recently sent by the writer to about thirty-five medical institutions asking for information on the subject. Colleges were selected which by reason of standing, endowment, equipment, number of students, etc., were likely to employ the best and most modern methods of teaching. Answers from thirty were received. Only three colleges give the course in question. Some express regret that the course is not given, others hope to see it established.

The medical colleges which give the course are:

Barnes Medical College, St. Louis, Mo.

Dartmouth Medical College, Hanover, New Hampshire.

Medical Department, University of Virginia, Charlottesville, Va.

To this number should be added:

The College of Physicians and Surgeons, Columbia University, New York City.

There are at present approximately 160 medical colleges in the United States, of which only 122 are so-called regular schools, the others being homœopathic,

* Read before the Society of the Alumni of Bellevue Hospital, February 5, 1902.

eclectic, physiomedical, etc.* If the proportion of answers received be taken as a ratio, then ten per cent. of these colleges give a laboratory course of physics. Probably five or six per cent. is a more correct estimate.

Among those that do not give the course are the following:

Cornell, Harvard, Johns Hopkins, Tulane, Rush Medical College (University of Chicago), University of Pennsylvania, and Yale.

The object of this paper is to show that a laboratory course of physics is important in the study of medicine, and also to point out that a course of much value can be completed in a comparatively short time, provided the experiments are properly selected and certain methods of instruction are carried out.

THE IMPORTANCE OF LABORATORY WORK.

The laboratory method of instruction has been recognized as essentially important in scientific, technical and engineering schools, and has grown in favor continually during the last twenty years. It has been adopted in medical colleges in many subjects, including anatomy, chemistry, physiology, and others, where it is also acknowledged to be essential.

Dr. C. S. Minot, of Harvard, in his address at the Yale University Medical Commencement in 1899, spoke thus of the laboratory:† 'Knowledge lives in the laboratory,' and again, 'Our greatest discovery in scientific teaching is the discovery of the value of the laboratory and its immeasurable superiority to the book in itself.'

"A lecture is a spoken book, and must, therefore, also yield to the superior claims of first-hand knowledge."

In physics, laboratory work should be an organic part of a systematic course, and the course should consist of lectures, of experimental demonstrations by the lecturer, and of qualitative and quantitative experiments performed by the students themselves. Such a systematic course has been given to the first-year students of the College of Physicians and Surgeons, Columbia University, since 1893, when it was organized by the Department of Physics at the request and with the cooperation of the Faculty of Medicine. The laboratory part of this course is in charge of the writer and is described below:

THE LABORATORY COURSE OF PHYSICS FOR MEDICAL STUDENTS AT COLUMBIA UNIVERSITY.

The course consists at present of twelve periods of laboratory work of three hours each, followed by a final written examination on the salient points of the experiments performed in the laboratory. At the beginning of the course an introductory lecture is given, in which the object of the course, the methods to be followed, the rules for note-keeping, etc., are fully explained. At the same time, each student is provided with a suitable notebook and a printed form called the 'course-list,' containing a list of selected experiments. The course-list also contains a blank column in which is entered the date when each experiment is performed. The course-list is pasted in the front of the notebook and is of service as an index of the notes in the book. Another printed form, the 'time schedule,' is pasted in the back of the notebook, and in this the student is required to keep a record of each attendance. The time schedule is a help to the student in apportioning his time to the experiments in the course. The attendance is also entered on a general time sheet posted in the laboratory for purposes of laboratory record.

* 'Report of U. S. Commissioner of Education,' Vol. 2, 1898–99.

† 'Knowledge and Practice,' C. S. Minot, SCIENCE, July 7, 1899.

Rules for Note-keeping.—The principal rules for governing note-keeping are as follows: The notes must be a synopsis of the actual work performed and not a description of the experiment. They must be entered in pencil at the time when the experiment is performed, and in accordance with a simple form adopted. Also, they must be accompanied by diagrams illustrating the work, and systematic tabulations of the observations made in the experiments.

The Experiments Performed by the Medical Students.—Each student performs twenty-five experiments, twenty of which are prescribed and five of which he himself selects from the remaining experiments on the course-list. The prescribed experiments have been selected for the purpose of illustrating the important principles of physics which are of value in the study and practice of medicine. These experiments are divided between mechanics, heat, light and electricity. The present list is as follows:

Mechanics and heat:

1. Measurement of distances, inch and millimeter scales.
2. Measurement with the vernier.
3. Measurement with calipers and micrometers.
4. The barometer; reducing the reading to zero temperature C.
5. The analytical balance; weighing by swings and interpolation.
6. The Mohr balance; density of liquids.
7. The thermometer; correction of the boiling-point mark.

Light:

8. Focal length of a convex lens (three methods).
9. Focal length of a concave mirror (three methods).
10. Microscope; magnifying power (two methods).
11. Microscope objectives; tests for spherical and chromatic aberrations.
12. The spectrometer; complete adjustment.
13. The spectrometer; measurement of the angle of a prism.
14. The spectroscope; spectra of metals.
15. The spectroscope; absorption spectra of liquids.

Electricity:

16. Measurement of resistance by the substitution method.
17. Measurement of resistance by the difference of potential method.
18. Measurement of resistance by the Wheatstone bridge.
19. Measurement of electromotive force by the high resistance method.
20. Measurement of current by the voltmeter and the ammeter.

Approximately 160 medical students take the laboratory course each year. On account of this large number it has been found necessary to divide the class into four sections, which attend the laboratory on different days.

SYSTEM OF INSTRUCTION.

Time for completing experiments can be economized by proper direction of the instructor in charge and by proper appliances. In the present case, twenty-five experiments are performed in thirty-six hours, which is less time than is generally allotted to that number of experiments; yet perfectly satisfactory work is done by the medical students. This result is accomplished by the system of instruction employed, which is as follows: To each experiment is assigned a special table in the laboratory on which is permanently kept a set of the requisite apparatus. After the students have attended the introductory lecture they go from one experiment to another until they have completed the list. During the periods of laboratory work, there is one instructor to about every ten medical students, who is constantly giving instruction and directing the work.

Experiment Directions.—Typewritten experiment directions, concise and illustrated by diagrams, are used also, and so placed on the tables that students may easily refer to them. The text of each experiment direction is divided into two parts, each part being subdivided into several paragraphs, as follows:

First part:

(*a*) Object of the experiment.

(*b*) Theory and general explanation of the experiment.

(*c*) Description and explanation of apparatus used.

(*d*) Sources of error, precautions, etc.

Second part:

(*e*) Practical instructions, giving method in detail.

(*f*) Example, showing the form of entry of notes required in the notebook.

(*g*) Explanatory notes, references, etc.

GENERAL UTILITY OF THE COURSE IN MEDICINE.

The course is of value to the student as a means of understanding the great principles of physics that are intimately related to medicine. It has also an additional educational value of a more general nature. Some of the teachings of the physical laboratory are enumerated below. No argument is necessary to emphasize their importance.

The experiments show:

1. The necessity of working with method and with deliberation.
2. The value of precision and the cost of carelessness.
3. The necessity of taking every factor of an experiment into consideration and of attaching proper importance and significance to each.
4. The liability of making mistakes in method and errors in manipulation.
5. The limitations of accuracy in both experimenter and instrument.
6. The significance with respect to mankind of physical properties, forces and laws.

These important points are brought to the notice of the student by even a short course of quantitative experiments in physics, and we maintain that in no other way are they shown with such clearness. The medical student is apt to slight his general scientific training and to devote his entire energies to acquiring only that technical knowledge which he considers will be of 'practical' use to him in his profession. Thorough technical knowledge is necessary, but scientific training is equally important, for only through it can technical knowledge be applied to advantage. Medicine is every day becoming more of an exact science. Those of its departments in which progress has been rapid have demanded and received aid from physics, chemistry and biology.

PRACTICAL UTILITY OF THE COURSE IN MEDICINE.

The laboratory course, besides teaching scientific methods and fundamental laws of physics, has also a value that is distinctly practical for many physical instruments are used in medicine. The physician and the surgeon, moreover, are constantly called upon to devise special appliances, demanding of them a knowledge of physical manipulation and construction that can be acquired only in the laboratory.

As medicine becomes more of an exact science, the tests used in the diagnosis of diseases must be quantitative, requiring instruments of precision, having scales, verniers, micrometers and other measuring devices. Such instruments are used in medicine for the purpose of obtaining exact results. Some of these are enumerated below: The thermometer is one of the most constantly used instruments in medical practice. Clinical thermometers are used for determining body temperature, where an accuracy of at least one fifth of a degree is required; yet frequently they are found to have errors of a whole degree, the chief source of error being due to gradual change in the glass. It is therefore imperative that the physician should have a thorough scientific understanding of this important instrument and the modes of testing it. To the microscope is due the greatest advancement in medicine. It has been the means of discovering bacteria and showing the minute cells of the body tissues. Accurate medical diagnosis now requires that the bacteria and cells must be counted and measured, demanding of the physicist a further improvement of this essential instrument. The spectroscope has been used recently for the analysis of blood and presents a field for medical discovery.

Many physical instruments have been adapted to the uses of medicine and have been given special names.

The cyrtometer for measuring the curves of the chest, and the æsthesiometer for determining the sensitiveness of the skin, the cardiometer, and the pelvimeter are all only calipers of different designs. Hydrometers and certain graduated vessels are called lactometers, saccharometers, or albuminometers to indicate their special uses. The spirometer, which measures the capacity of the lungs, is usually a modified form of gas meter. The sphygmograph, which records the pressure of the blood, is a registering pressure gauge. The hæmoglobinometer, for measuring the amount of hæmoglobin in the blood, depends on a photometric comparison. In general surgery, levers, screws, clamps, pumps and other mechanical devices are used in many forms. In orthopædic surgery in particular complicated mechanical appliances are employed. These consist of clamps braces and screws which are put together in a variety of combinations. A special appliance is often required for each orthopædic case, requiring of the surgeon a knowledge of the principles of mechanics.

In the study of the ear the tuning fork is used for producing uniform waves of sound, and the acoumeter for measuring the acuteness of hearing, the manometer and the otoscope for observing and testing the mobility of the aural membranes. In the study of the eye a special photometer is used for determining sensitiveness to light, the ophthalmometer for measuring corneal images, the perimeter for measuring the field of vision, and the astigmometer for determining the amount of astigmatism.

Applications of Electricity.—The applications of electricity in medicine are increasing daily. In electro-therapeutics the direct and alternating currents have been used for many years, and recently the high voltage discharge from the static machine has proved valuable for the treatment of certain diseases. Electricity is used for cauterization, for eradicating tumors by electrolysis, and for illuminating the interior of the body in surgical operations. It is used in the production of X-rays, which are constantly employed in both medical and surgical diagnosis. No little electrical knowledge is required to operate X-ray apparatus. This knowledge must be practical as well as theoretical. In performing the electrical experiment in the physical laboratory the student uses, and becomes familiar with, various kind of batteries, different types of galvanometers, resistance boxes, switch keys, and various other forms of electrical apparatus. Some of this apparatus is always encountered when an electrical current is used. These are but examples showing the practical utility of a laboratory course of physics in medicine.

In Conclusion.—The study of medicine is long and difficult, especially when two years of hospital service are superadded to the course before private practice is begun; yet if a laboratory course of physics can be made of much value, the short time spent on it, for example thirty-six hours, seems a comparatively small part of the three or four years of study that are required in medical schools. In 1899 the total amount of work demanded of medical students, in order to qualify for the M.D. degree, in 26 out of the 156 institutions in the United States was 'over 4,000 hours.'* Inasmuch as the minimum requirement established by the Association of American Medical Colleges in June, 1899, was 'at least 3,300 hours,' it can be assumed that the 26 colleges mentioned above include the institutions of highest standing.

A laboratory course of physics of 36 hours, such as the one given at Columbia University, represents less than one per cent. of the total work required on the 4,000 hour basis.

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SOME PRELIMINARY EXPERIMENTS ON THE MOTION OF IONS IN A VARYING MAGNETIC FIELD.

THE experiments described below were suggested by the negative results of V. Crémieu's search for a force acting on a static charge in a varying magnetic field.† The scheme of the Crémieu experiment may be briefly described by the statement that a disc which was charged to a high potential was suspended in the field of a strongly excited electromagnet. Upon breaking the current the disc should have experienced a force in accordance with the Maxwell equation

$$\text{Curl}\, E = -\frac{1}{E}\frac{\partial H}{\partial t}. \qquad (1)$$

The quantity of electricity that can be placed on a body of considerable dimensions is comparatively small, so that in the case of the Crémieu experiment e/m was a small quantity.

It occurred to me to use the negatively charged ions in an ionized gas as the carriers of the static charge; in the case of ions e/m is very large, being about 4×10^{17} E.S. An ion, because of its high charge, should move with considerable velocity in a varying field of moderate strength. For the purpose of showing the theoretical magnitude of such ionic motion in such a field I will assume an ideal case. Suppose that a cylindrical vessel is placed in a coil of a few turns through which is passing an oscillatory current of high frequency. Assume that there is a complete vacuum except for one negative ion which at the initial time is at rest at a distance r from the center of the coil. The ion will be acted upon by a force the direction of which will be a circle of radius r about the magnetic center of the coil. Neglecting the centrifugal acceleration and the change in apparent mass due to its motion, if the maximum strength of the field at the position of the ion is 100 C.G.S. and the frequency is 10^6, it may be shown that the ion would execute a harmonic oscillatory motion in a circular path around the center, with a maximum displacement from the position of rest of 20 cm. and a maximum velocity of 13×10^7 cm. per second.

Since for the purpose of experiment, it is desirable to have ions in abundance and a rapidly varying magnetic field, I have made use of the well-known electrodeless discharge in the Tesla oscillatory field, as in this form of discharge the gas is highly ionized and the field is of high frequency. In the actual phenomena the amplitude is of course many times smaller than that calculated above. The ions probably move but a short distance and are then stopped by collisions with the molecules, producing by the collision many other ions which by impact produce yet others and thus the effect accumulates until a strong current, the ring discharge, is produced.

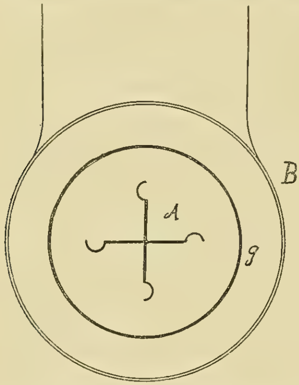
To demonstrate by experiment that some such motion actually exists I have made

* 'Education in the United States,' N. M. Butler.

† Crémieu, *Annales de Chemie et Physique*, 7th Series, I., 24.

use of a miniature anemometer similar to those I have used to show the oscillatory motion of the air in a stationary sound wave.*

The anemometer possesses the convenient property of rotating in one direction, whatever may be the direction of the particles acting upon it, so that an oscillatory motion of the ions should produce rotation provided their amplitudes of oscillation are at least as great as the radius of the cups.



The arrangement of the apparatus was as follows: Four large twenty-liter Leyden jars were joined two in parallel, the inner coatings of each pair being connected with the spark gap and the outer coatings with the coil *B*. Within this coil, which consisted of eighteen turns of coarse wire, was placed a cylindrical glass vessel *g*, 5½ cm. in diameter. The vessel was in permanent connection with a mercury air pump. A miniature anemometer *A*, consisting entirely of glass, was mounted on a needle point so as to turn with great freedom. The anemometer was 3½ cm. in diameter and the cups, which were half cylinders, were each 2 cm. long and 6 mm. in diameter. Between the coil and the vessel was placed a Faraday cage, which was made by attaching narrow strips of tin-foil on a glass cylinder so that the strips were perpendicular to the plane of the coil. This was found to shield the vessel very well from external electrostatic effects. The jars were charged by a large induction coil excited by an alternating current of forty complete periods per second. The length of the spark gap was 11 mm. When the proper degree of exhaustion was obtained, upon the passage of the sparks, the white ring discharge was produced and the anemometer rotated in the direction of the convex side of the cups.

The experiments are given below: Forward rotation signifies rotation in the direction of the convex side of the cups.

1. Pressure 3.6 cm. mercury. A faint red light in vessel. Anemometer does not rotate. Vessel cool.

2. Pressure 1.1 mm. The red light deeper and stronger. The anemometer does not rotate. Vessel cool.

3. Pressure .64 mm. The white ring discharge is obtained. Anemometer rotates forward about two revolutions per second. The vessel becomes very hot.

4. Pressure .17 mm. The anemometer rotates forward but not so rapidly as in experiment 3. After the interruption of the Tesla current the anemometer rotates backward. If the current is kept on for some time, especially when the vessel is wrapped closely in paper to confine the heat, the walls of the vessel become nearly as hot as the vanes of the anemometer and the anemometer rotates but very little backward.

5. Pressure .058 mm. Immediately on the appearance of the white electrodeless discharge the anemometer rotated backward. Upon wrapping the vessel with felt or paper to confine the heat the following is observed: When the current is turned on the anemometer rotates at first back-

* *Amer. Jour. Sc.*, February, 1902.

ward; after a short time it turns more slowly, stops, and then rotates forward. This can be continued but a short time as the temperature becomes so high as to endanger the anemometer.

6. Pressure .024 mm. The anemometer rotated backward, but when the vessel was wrapped with a non-conductor of heat it rotated forward as in experiment 5.

7. Pressure .0017 mm. The electrodeless discharge was not obtained and the anemometer did not rotate. Vessel remained cool.

8. In the experiments 1 to 7 the distance from the outer edge of the anemometer cups to the walls of the vessel was about 1 cm. Another vessel was used also in which the cups were much nearer the walls. With this the backward rotation was much stronger in all cases. The pressure at which the backward rotation was first obtained was much higher than in experiments 4 to 7.

9. In this experiment the vessel contained a small mill which was similar in construction to the anemometer, excepting it had *flat* vanes. This did not rotate at any degree of exhaustion in the strongest discharge that could be obtained.

10. A much larger vessel was used for this experiment. It was 12 cm. in diameter and the anemometer was but 3 cm. in diameter, so that the distance between the walls and the cups was 4½ cm. The rate of rotation was surprisingly great, attaining a velocity of forty revolutions per second. At no degree of exhaustion did the anemometer rotate backward. This indicates that at this great distance (4½ cm.) between the walls and the cups there is no radiometer effect. It is perhaps desirable also to mention that a vessel was constructed having two anemometers, one above the other, mounted with the convex sides turned in opposite directions. At the proper degree of exhaustion these rotated in opposite directions, each turning in the direction of the convex side of its cups.

The backward rotation appears to be due to the heat interchange between the convex side of the cups and the walls of the vessel, because: (1) By experiment 4, the anemometer is acted on by a force driving it backward, which persists for some time after the current is interrupted. This force is much less when the cups and the vessels reach nearly the same temperature. (2) By experiments 5 and 6, the backward rotation is only obtained when there is heat interchange between the cups and the walls. The effect of wrapping the vessel with a non-conductor of heat is to make the inner surface of the walls nearly as hot as the cups of the anemometer. When this condition is obtained, the backward force nearly disappears and the forward force due to ionic motion predominates.

This backward force appears to be a true radiometer effect since it increases as the vacuum becomes higher. In experiments 3 and 4 the distance from the cups to the walls is probably greater than the mean free path of the molecules and the radiometer effect is small. In experiment 8 the radiometer effect is stronger and appears at a higher pressure as the cups are nearer the walls and the mean free molecular path necessary for a radiometer effect is shorter.

We may regard the molecule from which the negative ion has been separated as a carrier of a positive charge, and so it also will be acted upon by the varying magnetic field. Its velocity and amplitude will be much less than that of the negative ion. The amplitudes will be inversely proportional to the square roots of their masses, since the energy is the same in both cases. If their amplitudes are of the same order of magnitude as the radius of the cups, the positive ions will act on the anemometer also.

There are thus two opposing forces acting on the anemometer, the one due to the motion of the ions and the other due to the transfer of heat from the centers outward. The direction of rotation depends upon which of these forces is in excess. No attempt has yet been made at quantitative measurements, although such measurements could probably be made by a torsional suspension of the anemometer in a vessel as large as that described in experiment 10.

It is my hope in the near future to investigate a possible difference of potential between the walls and the center of the vessel, and also to study the motion of the cathode rays in a Tesla field.

In addition to furnishing direct support to the Maxwell equation, the experiments may be of some value from their bearing on the electron theory of electricity. The electrodeless discharge consists of a rapidly alternating current of electricity similar to that which would be produced in a metal ring placed within the coil. It thus appears that such current is at least accompanied by ionic motion even if such motion does not constitute the current itself.

Bergen Davis.

Göttingen, February 17, 1902.

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*THE TROPICAL LABORATORY AT MIAMI, FLORIDA.**

The extent to which the government of the United States is making provision for scientific investigation in connection with the work of its various departments, notably that of the Bureau of Plant Industry, is a matter of congratulation. To scientific workers especially, it is a gratifying fact that the laboratories established primarily for the study of plant diseases and other subjects of a practical nature are being thrown open to investigators of widely different aims, their facilities being freely placed at the disposal of students engaged in any line of research whatever. One of these, the Tropical Laboratory of the United States Department of Agriculture, has been established so recently and offers such exceptional advantages that its location and facilities should be widely known. This laboratory, located at Miami, Fla., in 1899, was formally established under its present name in 1902. After the discouraging failure of much of the experimental work at Eustis, Fla., occasioned by the disastrous freezes of 1894–95, it became apparent that another place must be selected less subject to climatic vicissitudes, and thus far there is every reason to believe that the location now chosen will admirably fulfil the requirements for such a station.

Miami is situated a little south of the twenty-sixth parallel of latitude, in direct communication with the north by rail, and with Nassau, Havana, and Key West by the Peninsular and Occidental Steamship Line. The city, only a few miles from the Everglades, is healthfully built on the coral breccia which forms the underlying rock, and looks out on Biscayne Bay, landlocked by the northeastern extension of the Florida Keys. Its delightful climate, permitting all sorts of outdoor study and exploration in midwinter, is not the least of its many advantages. The laboratory, situated a mile south of town, is easily reached in ten minutes by wheel over a smooth rock road. Six acres of land belong to the station, upon which experiments in acclimatization and plant breeding are in progress. The laboratory building is a plain but substantial and well-arranged structure, with office and library in which are shelved upwards of two thousand volumes, including pamphlets and periodicals, among which are the *Botanisches Centralblatt*, *Botanischer Jahresbericht*, Science, the *Botanical Gazette* and other current

* Read before the Michigan Academy of Science, March 27, 1902.

literature, largely botanical and horticultural. The director's private laboratory is equipped for chemical, microscopical and bacteriological work, and a similarly situated room is fitted up for the laboratory assistant. A well-lighted room with tables, sink, gas connections and other conveniences is reserved for the use of investigators, and during the past year several representatives of northern universities have availed themselves of the privileges thus offered. The director, Professor P. H. Rolfs, has extended every possible courtesy to myself and others, and has made the conditions for work well-nigh ideal. Although his time is very fully occupied with investigations and experimental work, it is his expressed wish, in accordance with the liberal policy of the Bureau of Plant Industry, that qualified investigators should avail themselves freely of the privileges of the laboratory.

The work now in progress at the Tropical Laboratory includes a continuation of experiments interrupted at Eustis, and many others which cannot be described here. The production of hybrid oranges with a view to obtaining a variety that is hardy and at the same time possessed of other desirable qualities, the breeding of refined strains of the pineapple, acclimatization of promising varieties of mango and other fruits, the adaptation of Peruvian corn to Florida lands, and experimental cultivation of forage plants, grains, and other plants of economical value from all parts of the globe, constitute a portion of the work undertaken, no small part of which has reached a point at which a successful issue may be hopefully anticipated.

Recurring to the opportunities offered to students of biological problems, more particularly those in which botanists are interested, there are certain lines of work specially favorable for extended study, largely on account of the great wealth of material always close at hand. One of these involves further investigation of climatic influences in determining both the range and habits of plant species. The whole matter of acclimatization and the limits within which given varieties are capable of normal development is of such obvious economical importance that it has become, as already noted, a leading subject of investigation on the part of the Bureau of Plant Industry, but the habits and structures of native species, in evident adaptation to rainfall and other factors, though so striking as to attract the attention of every intelligent observer, have been very inadequately studied. The great preponderance, in southern Florida, of one particular mode of adaptation to xerophytic conditions and the partial adoption of this form by species not yet fully adapted to their surroundings suggest one of the many fruitful lines of study that are offered here under most favorable conditions. Equally important, and doubtless quite as promising, is a study of soil conditions, which here plainly exert a marked and even determining influence on the vegetation of particular areas. So apparently simple a matter as a demonstration of the origin of the 'hammocks' has not yet been accomplished. Their interesting and obvious resemblance to islands, as pointed out by some writers, is highly suggestive, but gives no account of their actual history.

The investigation of these and similar questions will naturally be accompanied by a more extended comparison than has yet been made of specific and representative forms common to southern Florida on one hand and the West Indies and more northern regions on the other. Such a comparison should involve much more than a mere enumeration of common species. Differences of form and habit, requiring for their observation some degree of expert knowledge, must be noted where the plants are growing, since in many cases herbarium material is entirely inadequate for the purpose.

Without attempting further enumeration or suggestion, it may be said in brief that for the study of tropical and semitropical plants, both native and introduced, the investigation of habit and structure as adaptations to both climatic and edaphic factors, and the demonstration of various existing facts of plant distribution as a phase of geological history now in progress, the Tropical Laboratory at Miami offers advantages that can hardly fail to attract and reward earnest students for years to come.

V. M. Spalding.

Miami, Fla.,
February 27, 1902.

HENRY MORTON.

The death, in New York city, May 9, of Dr. Henry Morton, President of the Stevens Institute of Technology, removes from the stage one who cannot be replaced either in the field of his work or in the hearts of his friends. Nor can his work be fully appreciated by any one man or by any one class of men, so varied has it been in character, in its fields of action and in its specialization.

Physicist and engineer; chemist and educator; investigator and legal expert; linguist, editor and writer; man of business and philanthropist; pioneer in the reduction of the art of the mechanic and inventor to a professional and scientific form; mechanic, inventor and organizer and administrator: his many-sidedness necessarily precludes alike appreciation, correct judgment and exact quantitative measurement of his life's work. Whoever studies the life of the man and endeavors to weigh his work and its productive value to the world will at least conclude the investigation impressed with the conviction that this was the rarest of rare cases, that of the man of genius, at once brilliant and versatile, and fruitful of good works in many departments ordinarily supposed to be far separated, as vocations, by the constitution of the human mind. But heredity, environment and an irrepressible ambition conspired with extraordinary powers to make this life fruitful, both in opportunity and in accomplishment.

Henry Morton was born in New York city, December 11, 1836, the son of the late Rev. Henry J. Morton, Rector of St. James' Church, Philadelphia, and the grandson of Col. James Morton, a patriot of the Revolution, inheriting strength and talent from earlier generations of well-known families. He was educated at the University of Pennsylvania.

While still an undergraduate he undertook with classmates the translation of the parallel texts of the famous Rosetta Stone. Mr. C. R. Hale translated the Greek and the Demotic texts and Morton the hieroglyphics. Young Morton also made the smooth manuscript and illuminated it with a skill and taste which proved his inheritance from his father of remarkable artistic ability. This work was published at the suggestion of Henry D. Gilpin, later U. S. Attorney-General, and was edited by Morton, who actually reproduced the manuscript on the lithographic stone and all its illustrations. The extraordinary task was completed and the book issued from the press in the latter part of the year 1858, a volume of 172 pages with 100 illustrations. The book remains one of the famous and rare works in its department. It was commended in enthusiastic terms by Baron Humboldt.

On leaving college, Morton delivered the valedictory address and in admirable verse. His talent as poet continually came to the surface, even in later years and in the midst of the most engrossing occupations.

He entered upon the study of law, which he soon deserted, compelled by his inclination toward the physical sciences, the study and the practical investigation of which, together with mechanical occupations, had been his habitual amusements from childhood. He began his life as educator by accepting a lectureship at the Episcopal Academy of Philadelphia, his own preparatory school. He instantly became distinguished as a lecturer, and his clearness of demonstration and the brilliancy and ingenuity of his experiments, at the time unprecedented, continued to contribute to his fame throughout his life and were never excelled, if ever equaled, by later and noted scientific lecturers.

In 1863 he became Professor of Chemistry at the Philadelphia Dental College, in 1864 Secretary of the Franklin Institute and in 1867 the Editor of the *Journal of the Franklin Institute.* Meantime, his public lectures attracted enormous audiences and his ingenious, original and tremendously impressive experimental illustrations gave him a standing beside Tyndall as a popularizer of science and perhaps placed him fairly above that great genius in this feature of his lectures.

As editor of the *Journal of the Franklin Institute,* Morton accomplished an admirable work. He secured the contributions of men of science and of technical and industrial writers foremost in their respective departments, and his journal soon commanded the respect of the great authorities on both sides of the Atlantic. This periodical, founded in 1826, is quite as well known abroad as at home, and files may be found throughout Europe. It had long been accepted as a leading organ of technically applied science; but, under the direction of the young and active and talented man now coming to the editorial chair, it became still more widely known and exchanged with the important scientific and technical periodicals of all countries. The Abbé Moigno, editor of *Les Mondes,* the well-known French journal of science, Dr. Schellen and many other famous men of the time were among the friends made by the young editor through his work on the *Journal.*

In 1868, Professor Morton was made *ad interim* Professor of Chemistry and Physics at the University of Pennsylvania, in the temporary absence of Professor Fraser, and, in 1869, he was given an independent chair of chemistry. In the latter year he took part in the work of the U. S. Solar Eclipse Expedition and obtained exceptionally fine photographs of the eclipse. He discovered and explained the cause of the bright line on the disk of the sun beside the edge of the moon. This he showed to be purely a photographic phenomenon. His work attracted the attention and commendation of Airy, De la Rue and other astronomers. His pen was prolific of original and useful papers at this time, and their almost invariable reproduction abroad testified to their admitted value among men of science throughout the world.

In 1870 came Morton's great opportunity. By bequest, Mr. Edwin A. Stevens, of Hoboken, had provided for the foundation of 'an institution of learning' which was to be organized for the benefit, particularly, of 'the youth of the State of New Jersey.' The testator and his executors were alike without any definite idea of the form most desirable for such an institution. Professor Morton was consulted and, at his suggestion, the trustees concluded to make the new 'institution of learning' a school of mechanical engineering. At the time, as Morton pointed out, there were schools of civil engineering practically competent to supply all the instruction then demanded by aspirants for admission to that branch of the profession of engineering; but there were no schools of the mechanic arts and of mechanical engineering, while the requirements of the rapidly growing industrial system were certain to make an early and imperative demand for professionally trained mechanicians and engineers. This prophecy was soon shown to be correct.

President Morton took his place as the head of the new school in 1870, promptly selected his faculty and organized the institution, in accordance with the accepted plan, in 1871. Its success was instant and the thirty-two years which have elapsed since the foundation of the Stevens Institute of Technology have seen steady progress in numbers and in quality of its alumni, in the character and extent of its curriculum and in the amount of fruitful research and valuable engineering data experimentally obtained through the able and unintermitted work of its faculty. It promptly assumed and permanently retained a place among leading professional schools.

The president set an admirable example of enterprise and industry and his life, from this time on, was one of great productiveness. The administration of the college, the prosecution of experimental investigations and the studies compelled by calls upon him for testimony in the courts as an expert in the departments of applied science, in which work he soon became, as everywhere, distinguished, completely put an end to his public lectures and reduced his authorship to a minimum. The new institution, however, was always a first consideration and he was always ready to make any personal sacrifice to insure its successful development.

In the early days of this period, Morton carried on his scientific researches as best he could in the midst of the constant calls of duty and the distractions of a busy life. He studied the fluorescence and the absorption spectra of over eighty uranium salts, publishing results on both sides the Atlantic. In 1873 he similarly studied the petroleum products, anthracene, pyrene, chrysene, and published valuable papers regarding them in the years 1872 to 1874. He discovered 'thallene,' and its modification 'petrolucene'; which substances have extraordinary fluorescent properties. His inventiveness was illustrated in everything undertaken by him; but one of his most useful devices was his new form of projection lantern, permitting the exhibition on the screen of a great variety of experiments which, previously, could not be satisfactorily displayed. This apparatus greatly interested Professor Hoffman, who visited the country a short time after its production. He independently discovered 'flavopurpurin,' though himself crediting Auerbach with its first production. It proved, later, that Auerbach made 'isopurpurin,' a mixture of anthrapurpurin and flavopurpurin. The demands of expert work led the young chemist and physicist into many interesting and often important researches, and his coolness, courage and entire confidence in his plans and processes were often strikingly exemplified, as by his work in distillation of nitroglycerine and in conducting investigations involving the employment of steam at above twenty atmospheres' pressure.

His expert work proved a lucrative as well as an attractive and interesting field for the display of his talents and, vastly more important from his own point of view, it gave him means for promoting the success of his college of engineering. He turned back into its treasury probably the full equivalent of the salary of the president, and never allowed an important opportunity to advance the work of the Institute to pass for want of funds when he could supply them. Besides many smaller and often unnoticed contributions, he provided, in 1880, a new workshop; in 1883 he organized at his own expense a Department of Applied Electricity; in 1888 he organized the Department of Engineering Practice, in both cases contributing liberally toward the equipment and endowment of the new chairs. In 1892 he placed an additional $20,000 in the hands of the trustees for this last-named department. Later, at the celebration of the twenty-fifth anniversary of the organization of the institution, he gave it about $25,000, in 1900 $15,000 and again in 1901, $50,000. His total contributions to the funds of the college probably amounted to $150,000, including numerous small and unrecorded gifts of apparatus.

President Morton in 1878 was elected a member of the U. S. Lighthouse Board, filling the vacancy produced by the death of Professor Henry. He was a member of the National Academy of Sciences from 1873. He was Ph.D. (Dickinson, 1869, Princeton, 1870) and in 1897 was made D.Sc. (Pennsylvania) and LL.D. (Princeton). He was a member of many learned and technical associations, at home and abroad.

The personal character of President Morton compelled respect and admiration. Cultured, scholarly, acute and brilliant, he exhibited in every way intellectual superiority. Broad-minded, of good judgment and possessing unusual force, his moral side was admirable and impressive. He was generous to a fault, liberal in sentiment, and devout. At home in all social relations and adapting himself to any society, he influenced strongly every person with whom he came in contact and his welcome was warmest in the most intellectual gatherings. His fine personality and his earnestness in the pursuit of his lofty aim compelled the sympathy and induced the active cooperation of Mr. Carnegie, and the most important and most valuable and productive of accessions to the equipment of his college was the recently erected 'Carnegie Engineering Laboratory.' He was himself generous to a fault in other directions than the promotion of technical education, and his friends and neighbors, both at his home in Hoboken and in his summer home at Pine Hills, testify to his constant and liberal contributions to all good works; so quietly and unobtrusively were these private philanthropies conducted, that it is probable that very few of his friends were aware of their extent.

The death of President Morton is an event of serious importance as a loss to science, to the cause of education and to a large social circle; it is a catastrophe for the institution over which he presided for so many years and which he brought to such a prominent position among professional schools, and to his family and friends. He will always have a memorial in his valuable contributions to science, and the already famous school organized by him will permanently stand a monument of larger real value and importance than that construction which commemorates its architect with the inscription *'Si monumentum requiris, circumspice.'*

R. H. THURSTON.

SCIENTIFIC BOOKS.

Hygiene for Students. By EDWARD F. WILLOUGHBY, M.D. London, Macmillan & Co. 1901. Pp. 563.

This excellent volume appears under a new title, but is in reality a fourth enlarged and improved edition of his 'Principles of Hygiene' first published in 1884. Dr. Willoughby needs no introduction to the American reader, since he has been for a number of years the European editor in charge of the Department of Hygiene and Public Health in the *American Journal of the Medical Sciences,* and we may expect therefore that he speaks authoritatively on all matters pertaining to his specialty. The volume is divided into six parts and twenty chapters. Part I. deals with the health of the man, and chapters one to six treat of the food-stuffs, stimulants, condiments, cooking and preparation of food, clothing, habits, exercise, rest, etc. Part II. is devoted to the health of the house, with chapters on sites and aspects for dwellings, ventilation, heating, lighting, plumbing, etc. Part III. deals with the factors which influence the health of the city, such as water supplies, sewerage and scavenging of towns. Part IV. deals with the health of the people, more especially the preventable diseases; chapter seventeen is devoted to school hygiene, and chapter eighteen to the health of the workshop; chapter nineteen to vital statistics and tables of comparative mortality, and chapter twenty to meteorology and climate. The presentation of the subject is clear, concise, logical and exact, and the student cannot fail to be impressed with the value of such a work. The summary of each chapter and the questions on each chapter will also serve a very useful purpose, in so far as they emphasize the salient points discussed.

In his chapter on food-stuffs, he points out the injurious effects of an excess or undue preponderance of one or the other of three principal alimentary principles, viz., the albuminates, fats and carbohydrates, which should prove of great practical value.

The chapter on stimulants and condiments is a very able presentation of the physiological effects of these so-called accessory foods, which when taken in moderation are what the Germans call 'Genussmittel,' or means of enjoyment, as contrasted with the true foods or means of nourishment. The author's views on the subject of the use and abuse of alcohol are quite in accord with scientific facts, and his summary reads: 'Alcohol is a stimulant for good or ill, in excess narcotic, habitual excess leads to degeneration of the tissues, especially of the brain and liver.'

Our knowledge of the effects of alcohol may be summed up as follows: In moderate and diluted doses it evidently stimulates digestion, as shown by its beneficial effects after a hearty meal, but large quantities interfere with or arrest the peptonizing process and frequently produce acute gastric catarrh. These effects are observed when alcohol is present to the extent of 10 per cent. of the gastric contents. Alcohol also exerts a marked diuretic effect which is due to a direct irritation of the renal epithelium. The habitual use of immoderate doses produces chronic gastric catarrh, with consequent impaired digestion and nutrition. It produces fatty degeneration of the heart, liver and arterial coats, probably because it promotes the conversion of albuminoids into fats, the connective tissue of the body increases in amount and its subsequent contraction gives rise to cirrhosis of the liver, Bright's disease and chronic meningitis. Alcohol also produces structural changes of the cells of the brain and spinal cord and leads to a general physical, mental and moral deterioration, which is often transmitted to the offspring.

On the whole we may conclude that alcohol is an accessory food of value only when it becomes necessary to increase temporarily the elasticity of mind and body and a desire and capacity of work, but the subsequent depressing effects and the baneful influence of its misuse should make us careful in its employment even for therapeutic purposes, especially when rest, proper food and some of the alkaloidal beverages and stimulants may accomplish the same purpose. For persons in health, alcohol in any form presents no advantages not found in other food-stuffs or stimulants, and which are, moreover, free from the dangers attending its use. While it is quite true, as expressed by Dr. Gairdner, that alcoholic drinks are at times a very enjoyable and harmless luxury when honestly tested by experience and kept within bounds by reason and prudence, the facts are that during the past decade there has been a marked increase in this country in the rate of Bright's disease, heart disease, dropsy and pneumonia, and the immoderate use of alcoholic beverages may be a factor in the development of these diseases.

Chapters six, seven, eight, nine and ten on habits, exercise, rest, sleep, idiosyncrasies, heredity and the hygiene of habitations are of special interest to the general reader.

Chapter ten on potable waters and the effects of impure water; Chapter twelve on water purification, and Chapter thirteen on scavenging of towns and sewage disposal, are very complete indeed for a book of this size. Under the head of sewage disposal he has withdrawn all descriptions of the chemical methods of treatment, but has very fully explained the theory and working of the bacterial tank and filters, which he very justly maintains should be adopted wherever irrigation cannot be advantageously carried out. His discussion of river pollution by the general introduction of sewage and the wastes of human life and occupation is brief, but sufficiently pointed to show that few streams can be used with perfect safety as sources of public water supply.

In speaking of the disposal of the dead, the author makes a strong plea for cremation, but deems it in the highest degree improbable that, for many generations at any rate, there will be any appreciable change in the practice of interment, sanctioned as it is by usage, sentiment and prejudices. He considers the fear that cremation would, by precluding subsequent examination, serve to conceal, if not offer an inducement to, crime as exaggerated or groundless, and shows how cremation might be made to lead to the detection of crime as it has already done in Italy, by exacting a more rigid system of certificates of death from the medical attendant, and in doubtful cases a post-mortem examination.

Chapters fifteen and sixteen, on preventable diseases, immunity and disinfection, are fully up-to-date and of great value, as is also the chapter on school hygiene, especially the discussion of the excessive and misdirected mental work. His long and practical experience as a physician, sanitarian and school manager entitles him to speak with authority on the subject. His chapters on the health in the workshop, comparative mortality of various professions and trades, meteorology, climate and health resorts contain a fund of useful information not generally found in a work of this character. On the whole the student of hygiene is to be congratulated upon the appearance of this very accurate and complete book.

GEO. M. KOBER.

Forstästhetik. By HEINRICH VON SALISCH. Berlin, Julius Springer. Second edition. Octavo, paper cover. Pp. 314. Illustrated with sixteen full-page heliotypes and fifty-nine half-tones and figures.

This book treats of woodland scenery in its relation to the science of forestry. The author describes in detail the scenic beauty of the artificial forests of Germany. These have long been subjected to systematic methods of treatment, and although the ostensible object has been solely to increase the practical value of the forests, they have incidentally been given a distinctive character that is well worth our study. The subject should interest Americans because the forestry movement that is now so rapidly gaining ground in the United States must, in its practical application, ultimately affect our wooded landscapes.

The book comprises two parts, the first of which opens with an introductory chapter on the relation between the economic and the æsthetic aspects of forestry. Then follow several chapters on the nature of beauty and our capacity to understand its various modes of expression. The remainder of Part I. shows how this beauty is revealed by the various components of the forest.

In Part II. the author enters into a careful discussion of the æsthetic effects that are due to the various operations of forestry, such as the construction of road systems, the choice of species in renewing the forest, the methods of sowing and planting, and the different systems that regulate the cutting of the timber. The concluding chapters treat of certain principles of landscape art that in the author's opinion may advantageously be applied to the practical forestry of Germany.

The author is thoroughly familiar with his subject in its utilitarian as well as its æsthetic aspects, and has produced a work of decided value. His manner of treatment shows exceptional powers of discrimination, particularly in matters of taste. The book contains many extracts from writers who have incidentally touched upon forest æsthetics, thus affording an opportunity for a broad but liberal criticism of the various points of view. While Mr. von Salisch therefore does not claim originality for some of the ideas advanced, and while it may even be said that his book is in several respects incomplete, he has at least given unity and connection to the scattered materials at his command. Moreover an interval of seventeen years, which has elapsed between the first edition and this second appearance of the work, has enabled him to enrich it with many new thoughts and suggestions and to add a number of beautiful and interesting illustrations.

Mr. von Salisch's book is unique in that it presents the first comprehensive discussion of forest æsthetics. It will commend itself to landscape artists, in spite of the fact that certain portions are technical and can be thoroughly understood only by persons who are familiar with the subject of forestry. It should have distinct value for the student of æsthetics, especially Part I., which contains many interesting suggestions regarding the philosophy of beauty. But to the professional forester 'Forstästhetik' should prove especially valuable and interesting because it throws a flood of light upon the broad possibilities of his profession. As our country is devoting more and more attention to conservative forestry, he naturally asks how his work will affect the natural beauty of our landscapes. 'Forstästhetik' shows him how the beauty of a forest may be brought out to special advantage by a forester of taste without affecting its usefulness, and is thus calculated to give him a clearer insight into the scope and dignity of his profession.

G. Frederick Schwarz.

Bureau of Forestry.

Elementary Zoology. By Vernon L. Kellogg. New York, Henry Holt and Company. 1901. Pp. xv+492.

Kellogg's 'Elementary Zoology' is planned to meet the requirements of a laboratory guide and of a reading text in introductory zoology. The book is divided into three parts: the first dealing with the structure, functions, and development of animals, the second with systematic zoology, and the third with animal ecology. The text proper is followed by appendices on the needs of the pupil, the equipment of the laboratory, and the rearing of animals and the making of collections. The volume is concluded by a good index to subjects and illustrations.

Judged from the standpoint of a laboratory guide the book gives a wide selection of types, and these are dealt with in an unusually satisfactory way for an elementary treatise, the descriptions being neither too exhaustive nor too superficial. Everywhere, however, too much information is given the student. Why ask if the alimentary canal of the toad (p. 8) is uniform in character, and in the same paragraph describe the stomach as an *enlargement,* the small intestine as *slender,* and the large intestine as *larger* than the small intestine? With figures and with descriptions of this kind the book is bound to sap most of the life from the laboratory work. A good laboratory guide should be built upon leading questions, which incidentally include a good terminology, and it should be in the main without illustrations. It follows from this that a book designed to be of an informational character and also a laboratory guide is bound to be somewhat of a failure in one direction or the other.

From the standpoint of an elementary reading text much can be said in favor of the volume. It is written with unusual accuracy and the small errors so commonly met with in elementary works of this kind are here noticeably absent. The defects are chiefly omissions. It seems hardly fair to use the title zoology for a book that nowhere contains even a brief exposition of the animal body as a working machine, and that from cover to cover makes no mention of the host of animal forms known only as fossils. Of course, the chief task of the author was to omit, but it seems scarcely wise to carry this to the point of excluding the fundamental results of animal physiology and of paleozoology.

As a piece of book-making the volume is serviceable. The search for novel illustrations has often led to the use of poor photographs where good drawings would have been much better. It is questionable whether the pupil will gain much from such a figure as that of the cross-section of the pupa of a bee (p. 199) and the expert will certainly not regard an illustration of this kind as a triumph of the art of photomicrography. Nevertheless many of the figures, particularly those in the chapter on birds, are of an unusually high order. Although the book cannot be described as a well-balanced zoology, and is open to serious objections as a laboratory guide, its clear and truthful presentation of many elementary facts will certainly gain for it a wide circulation.

G. H. PARKER.

HARVARD UNIVERSITY.

SCIENTIFIC JOURNALS AND ARTICLES.

WE note a little tardily *The Plant World* for March which contains articles on 'American Botanical Gardens,' by John W. Harshberger, a sketch of Lewis David von Schweinitz, by C. L. Shear and John Stuart Mill and 'Botanical Study,' by E. J. Hill. In the supplement Charles L. Pollard continues the description of the families of the Order Ericales.

The Osprey for April has a paper on 'The Feeding Habits of the Coot and Other Water Birds,' by Barton W. Evermann, and one on the 'Birds of the Marianne Islands and their Vernacular Names,' by W. E. Safford. The supplement, devoted to the General History of Birds, discusses the question of molt.

The Museums Journal of Great Britain for April has a flattering article on 'The Museums of Chicago,' by F. A. Bather, being a review of Dr. Meyer's memoir. But it is to be feared that we are not so well up in the matter of museum methods and general appreciation of museums as Mr. Bather thinks: it is one of the numerous cases of distance, etc. William E. Hoyle notes 'Some Useful Applications of Card Catalogues' and we have the usual number of interesting notes which do credit to Mr. Howarth's industry as an editor.

THE publication of the *Biological Bulletin* will be resumed in June, when the first and second parts of Volume III. will be issued. It will be published as heretofore, under the auspices of the Marine Biological Laboratory, and its scope will include zoology, general biology, and physiology. The editorial staff consists of Professors E. G. Conklin, Jacques Loeb, T. H. Morgan, W. M. Wheeler C. O. Whitman, E. B. Wilson and Frank R. Lillie, managing editor. In regard to the *Bulletin* Professor Lillie says: "There is in America no journal that takes the place of the *Biologisches Centralblatt* or the *Anatomischer Anzeiger* in Germany, although there is abundance of material to support such a publication. It is hoped that the *Bulletin* may occupy this field, and meet the need for rapid publication of results; the editors, therefore, undertake to issue one number each month, making two volumes a year, if the material offered is sufficient. The subscription price of the *Bulletin* has been fixed at three dollars for a volume of 300 pages; the low price makes it necessary to limit the length of the articles, and to exclude all lithographic plates. In no case will articles of more than twenty-five pages be included in any single number; but, in some cases, longer articles may be accepted, and published in installments. The cost of illustrations above $10 for any single article will be charged to the author, as will also be the cost of unusual alterations in the proof. The *Bulletin* will undoubtedly meet a real need; but the responsibility for its success rests with American biologists, and the editors therefore confidently appeal to them for their support. This can be most practically given in the two forms of subscriptions and contributions to its pages." All communications, subscriptions, and manuscripts should be sent to the managing editor, the University of Chicago, September 15 to June 15, or Wood's Holl, Mass., June 15 to September 15.

The Journal of Mycology, of which seven volumes were published from 1885 to 1894, is now resumed by Dr. W. A. Kellerman, Ohio State University, Columbus, Ohio, at the former price, namely, one dollar per year. It will be issued quarterly, the May number being the first for 1902 (Vol. 8); but the second number will appear early in June.

SOCIETIES AND ACADEMIES.

AMERICAN PHYSICAL SOCIETY.

THE April meeting of the Physical Society was held at Columbia University on April 21, this date being chosen instead of the usual one on account of the reception tendered on that day to the Society's only honorary member, Lord Kelvin. The meeting was the most largely attended in the history of the Society. The program, which was so extended as to make it hardly practicable to give an abstract of the individual papers, was as follows:

'Note on the Specific Heat of Mercury': H. T. Barnes.

'On the Theory of Concentration Cells': H. S. Carhart.

'An Apparatus for the Quantitative Study of Sound': A. G. Webster.

'The Magnetic Deviation of Rays from Radio-Active Substances': E. Rutherford and A. G. Grier.

'The Condensation of Nuclei': Carl Barus.

'A New Gravity Electrical Time Key': Chas. Forbes.

'An Electrical Method for Calibrating Chronographs': H. C. Parker.

'Absorption Curves for Condensers for Very Short Time Intervals': H. C. Parker.

'Residual Magnetism in Iron and Steel for Very Short Intervals of Time': C. C. Trowbridge.

'An Experiment Relating to the Application of Lagrange's Equations to Electric Currents': W. S. Day.

'The Physical Meaning of Mathematical Operations in Heat Conduction': A. S. Mackenzie.

'A New Method of Integrating one of the Differential Equations of Heat': R. S. Woodward.

'An Instrument for Drawing a Sine Curve': A. S. Mackenzie.

'Three Lecture Experiments': W. S. Franklin.

Ernest Merritt,
Secretary.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

The 552d regular meeting was held April 26, 1902. Mr. W. J. Spillman, of the Department of Agriculture, described 'A Machine for producing Normal Equations from Observational Equations.'

The work to be done in this case consists in multiplying each equation through by the coefficient of a given term of the equation, and in collecting the new coefficients of homologous terms into sums which are the coefficients in the normal equation. The method here described is applicable to cases where the number of terms in the normal equation is not greater than four. The machine contains a number of levers, pivoted at center, and graduated each way from the center to 10. The length of the graduations is arbitrary. Each lever is provided with four indicator slides, two on each side. The slides are set so as to point out on the lever scale the coefficients of the terms of an observational equation. The lever is then said to be set for that equation. From the slides cords pass upward to four systems of pulleys, in such manner that moving the levers vertically causes each cord to actuate an index finger attached to the uppermost pulley in each system. A convenient scale is arranged near one end of the lever, and is graduated into ten equal divisions, numbered from 0 to 10. The lever being raised from the zero to any point on this scale causes the index fingers to move on four similarly graduated arcs, and to point out on these scales the products of the coefficients by the number to which the indicator on the end of the lever points.

Other levers are set for other observation equations, as above. When any lever is raised so as to point to the number by which its equation is to be multiplied, the new coefficients of that equation are added to those already produced. When all the levers that are set are properly adjusted, the index fingers point out the coefficients of the normal equation.

A similar machine had proved very useful in problems requiring multiplication and summation of corresponding products.

The next paper was by Mr. L. J. Briggs, also of the Department of Agriculture, 'On the Absorption of Gases and Dissolved Salts by Quartz and Glass.'

In one series of experiments very finely powdered quartz was used and the weights of water vapor or carbon dioxide absorbed thereby were determined; these were found to be closely proportioned to the pressure of the vapor or gas. Similarly experiments were made with very dilute solutions of chlorides, carbonates and hydroxides of sodium, potassium and ammonium. The quantity absorbed increases much less rapidly than the concentration and appears with these salts to be dependent on the acid radical rather than upon the basic element. The importance of such investigations in their relations to soil-physics and scientific agriculture was pointed out.

Erratum.—In the report of the 551st meeting (SCIENCE, May 2, 1902, page 710) the statement regarding the consumption of liquid air should read fifty gallons per week.

CHARLES K. WEAD,
Secretary.

THE SECTION OF GEOLOGY AND MINERALOGY OF THE NEW YORK ACADEMY OF SCIENCES.

THE Section met on the 24th of April, and listened to the reading of two papers, abstracts of which follow:

Lea McI. Luquer, 'On the Determination of the Relative Refractive Indices of Minerals in Rock Sections by the Becke Method.'

In most schemes for the optical determination of minerals in rock sections, the birefrigence and resulting interference colors are made the basis of the scheme of classification. It is also desirable, however, to bring into consideration an approximate knowledge of the indices of refraction, and where the relative differences in the indices of two adjoining minerals are required, the method devised by Becke is found to be very convenient. This method depends upon the principle of the total reflection of light, and with proper adjustment of the microscope, which is to be focused sharply on the dividing plane between the two minerals, it is possible by slightly raising the objective, to observe a 'bright line' on the side of the mineral having the higher index of refraction.

The main precautions to be observed are that the cone of incident light be small, the sections very thin, the cementing material not much lower in refractive index than either of the minerals to be determined, and the plane of contact clear and nearly vertical. When the contact plane is much inclined, the method cannot be applied.

By this method very slight differences in refraction can be distinguished; as for example, between quartz sections cut parallel and at right angles to the optic axis with the difference

$$\varepsilon-\omega=0.009, \quad \varepsilon=1.553, \quad \omega=1.544$$

Dr. Luquer's paper has been published in the *School of Mines Quarterly* for January, 1902, pages 127–133.

Austin F. Rogers, 'The Minerals of the Joplin, Mo., Lead and Zinc District.'

The minerals of the Joplin district include sulphur, galena, sphalerite, covellite, greenockite, wurtzite, chalcopyrite, pyrite, marcasite, quartz, cuprite, pyrolusite, limonite, calcite, dolomite, smithsonite, cerussite, aurichalcite, hydrozincite, malachite, azurite, calamine, muscovite, chrysocolla, allophane, pyromorphite, barite, anglesite, leadhillite, caledonite, linarite, gypsum, goslarite, chalcanthite, melanterite, copiapite and bitumen, all of which have been found by the writer.

Lamellar twinning has been observed in galena, the twinning planes being vicinal tetragonal trisoctahedra. Covellite is found replacing sphalerite. Wurtzite occurs in distinct hemimorphic crystals, the first instance of the kind to be reported. Twin crystals of marcasite are common, among them cyclic fivelings. Quartz crystals are rare and small. Calcite presents an interesting field for crystallographic study, about twenty-four types with a total of twenty-nine crystal forms having been noted. Twinning according to all of the four laws for calcite has been observed. Some distinct crystals of aurichalcite confirm D'Archiardi's observations that the mineral is monoclinic and that the axial angle β is not 90°. Calamine occurs in doubly terminated crystals which show their hemimorphic character plainly. Seamon's theory as to the formation of calamine from 'tallow-clay' is not in all cases applicable. The rare copper-lead basic sulphates, caledonite and linarite, occur at one mine at Galena, Kansas. This mine also furnishes covellite, cuprite and aurichalcite.

The observed paragenesis generally follows this order: dolomite, galena, sphalerite, chalcopyrite, marcasite, pyrite, barite, calcite. The total absence of certain silicates and the rarity and small size of the quartz crystals strongly preclude the theory that the lead and zinc ores have been brought up from great depths by hot waters.

Attention was called to the coincidence in the location of the ore deposits of this and neighboring districts and the border areas of the Ozark uplift, as pointed out by Haworth.*

A fuller discussion of the minerals noted in this paper and their occurrence will be found in the forthcoming 'Lead and Zinc Report of the University Geological Survey of Kansas.'

Edmund O. Hovey,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

At the meeting of May 19, 1902, fifteen persons were present. Professor C. M. Woodward presented some notes on the 'Stresses in a Rotating Disk,' from which it appeared that the stresses in such a disk, as, for instance, in an emery-wheel or grindstone, when mathematically analyzed, are entirely tangential, notwithstanding the fact that the disk increases in diameter when rotated at a high rate of speed, so that the tendency to fracture is along radial lines. Professor Woodward also discussed the stresses in the disk when bound by a thin cylinder of greater strength and a high modulus of elasticity.

One person was elected to active membership.

William Trelease,
Recording Secretary.

THE PACIFIC COAST ASSOCIATION OF CHEMISTRY TEACHERS.

The Association organized last summer, held its first regular meeting as Berkeley, April 26, The Association was started during the session of the summer school of the University of California by a few teachers who were in attendance, and who realized the importance of a better understanding among themselves as to the proper methods of teaching chemistry. During the first six months of its existence a number of 'Circulars of Information' were issued, and the membership steadily increased until it now numbers about fifty. In April the Association had become strong enough to begin to hold meetings for the discussion of subjects of interest to the members. The first meeting was held in the chemistry building of the University of California and was attended by representatives from the principal schools in that part of the state within easy reach of Berkeley. Two subjects had been assigned for discussion, both dealing with the proportion of work that should be done by the teacher and the student respectively. But the discussion took a wider range and covered the entire subject before the meeting adjourned. While there was considerable difference of opinion as to methods, it was the unanimous opinion of those present that it is necessary to emphasize the practical, everyday side of chemistry to make it interesting and attractive to the beginner.

The Association is planning to hold its annual meeting in July during the summer school at the University, when teachers from all parts of California and the other Pacific states gather at Berkeley in large numbers.

Edward Booth,
Secretary.

University of California.

* *Bull. Geol. Soc. Amer.*, 11: 221, 1900.

DISCUSSION AND CORRESPONDENCE.

THE COMING MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Unfortunately the list of officers of the coming meeting of the American Association in Pittsburgh was dropped by the printer from the paged proofs of the Preliminary Circular, and the omission was not detected until the entire edition had been printed and mailed. That there may be no misunderstanding the list of officers for this meeting is herewith given:

OFFICERS OF THE PITTSBURGH MEETING.

President.

Asaph Hall, U. S. N., South Norfolk, Conn.

Vice-Presidents.

A—Mathematics and Astronomy, G. W. Hough, Northwestern University.

B—Physics, W. S. Franklin, Lehigh University.

C—Chemistry, H. A. Weber, Ohio State University.

D—Mechanical Science and Engineering, J. J. Flather, University of Minnesota.

E—Geology and Geography, O. A. Derby, Sao Paulo, Brazil.

F—Zoology, C. C. Nutting, Iowa State University.

G—Botany, D. H. Campbell, Stanford University.

H—Anthropology, Stewart Culin, University of Pennsylvania.

I—Social and Economic Science, Carroll D. Wright, Commissioner of Labor.

K—Physiology and Experimental Medicine, W. H. Welch, Johns Hopkins University.

Permanent Secretary.

L. O. Howard, Cosmos Club, Washington, D. C.

General Secretary.

D. T. MacDougal, New York Botanical Gardens.

Secretary of the Council.

H. B. Ward, University of Nebraska.

Secretaries of the Sections.

A—E. S. Crawley, University of Penna., Philadelphia, Pa.

B—E. F. Nicholas, Dartmouth College, Hanover, N. H.

C—F. C. Phillips, Western University of Pennsylvania, Allegheny, Pa.

D—C. A. Waldo, Purdue University, Lafayette, Ind.

E—F. P. Gulliver, St. Mark's School, Southboro, Mass.

F—C. W. Stiles, U. S. Department of Agriculture, Washington, D. C.

G—H. von Schrenk, Shaw School of Botany, St. Louis, Mo.

H—H. I. Smith, American Museum of Natural History, New York, N. Y.

I—(To be elected).

K—F. S. Lee, Columbia University, New York, N. Y.

Treasurer.

R. S. Woodward, Columbia University.

Inasmuch as it is always desirable that so far as possible those who attend the meetings of the American Association for the Advancement of Science should be sure when coming of comfortable quarters in which to lodge, I desire through the columns of SCIENCE to emphasize the importance of the recommendation made on page 22 of the Preliminary Circular, that the members of the Association correspond in advance with the proprietors of the hotels and the keepers of boarding houses in order to secure pleasant quarters. There is the more reason for this because of the fact that the President of the United States has signified his intention to be present in Pittsburgh to take part in the celebration of the Fourth of July, which is always celebrated in this city in a manner that is unique. It is highly probable that the city will be resorted to by a large concourse of people from all parts of the country. The sessions of the American Association do not conclude until the 3d, and it would therefore be well for members intending to be present to write at an early date, making sure of their accommodations. There is abundance of room at the service of the members, but prudence dictates that an early application for quarters should be made. In this connection I desire to call attention to the fact that very pleasant lodgings can be secured in the dormitories of the Pennsylvania College for Women, located in a delightful spot. Letters referring to accommodations at the college should be addressed to the Rev. Dr. Chalmers Martin, President.

The fact that the celebration of the Fourth to which I have alluded is practically coincident with the meeting of the American Association should not deter members from attending, but should be an attraction. An 'old-fashioned Fourth' in Pittsburgh is something which those who have witnessed it will never forget.

W. J. HOLLAND,
Chairman, Executive Committee.

AMERICAN CHEMICAL SOCIETY, SECTION C OF THE A. A. A. S.

THE American Chemical Society will hold its summer meeting, as usual, in connection with the meeting of Section C of the American Association for the Advancement of Science. These meetings will be held this year in Pittsburgh, Pa., Monday, June 30, to Thursday, July 3, inclusive. The sessions on Monday and Tuesday will be in charge of the American Chemical Society, with the exception of a short session of Section C, for the purpose of organization, immediately after the general meeting of the A. A. A. S. on Monday morning. The sessions on Wednesday and Thursday will be in charge of Section C.

The various papers presented, whether offered to Section C or to the American Chemical Society, will be classified, in so far as possible, under certain general topics, and in this manner will be distributed among the sessions throughout the week.

Brief abstracts of all original papers to be presented should be forwarded to the committee on program, W. A. Noyes, Terre Haute, Ind., Chairman, as early as convenient, and *not later than June 10.* Papers to be presented at the meeting are not necessarily in the same form as those prepared for publication. For public presentation few details should be given, and papers should consist chiefly of a clear and reasonably concise statement of the results which have been obtained and the conclusions reached. Abstracts should be accompanied with a statement of the time desired for the presentation of the paper. Persons presenting general addresses and reviews under special arrangement with the committee need furnish only a brief outline as an abstract.

Albert C. Hale,
Secretary of the American Chemical Society.
Brooklyn, N. Y.

Francis C. Phillips,
Secretary of Section C of A. A. A. S.
Allegheny, Pa.

ON PYRITE AND MARCASITE.

To the Editor of Science: In your number for November 1, 1901, abstract is given of an excellent paper by Dr. H. N. Stokes 'On Pyrite and Marcasite,' published in full in *Bulletin* No. 186, of the U. S. Geological Survey. The new method here proposed for quantitative determination of these minerals involves many intricate precautions which have been carefully and thoroughly worked out. So that although the process and apparatus seem to call for rather difficult manipulation, the method is likely to be very welcome to every student of this subject. Proper criticism of its details could only be justified by repetition of the process. In the absence of this I am entirely ready to accept its logical results, viz., that in this chemical method we at last possess a satisfactory means for discrimination of the two minerals and for approximate determination—to a degree of accuracy of within 1 to 3 per cent. in Dr. Stokes's skilled hands—of the amount of each in the generally composite specimens of pyrites found in nature.

There are certain inferences, however, which I cannot recognize as proved, in opposition to views advanced many years ago in my paper 'On the Variation of Decomposition in the Iron Pyrites; Its Cause, and Its Relation to Density' (*Annals of N. Y. Acad. Sci.,* Vols. III. and IV., 1887).

1. Dr. Stokes maintains 'that the hypothesis that most specimens of pyrite and marcasite, even when well crystallized, are mixtures of the two, or paramorphs, is without foundation.' Of the truth of that hypothesis, I think, much confirmation is found in the results obtained by this chemical method. In my paper (*loc. cit.,* pp. 179–180) it was pointed out for the first time 'that, on a fresh fracture, unaffected by alteration, the true color of marcasite is invariably *grayish white, nearly tin-white'*; while 'normal pyrite has a pale brass-yellow color' (p. 213). These color characteristics of the normal native minerals are accepted by Dr. Stokes, but further assumed by him as criteria for discrimination of the *pure* minerals, the very problem under investigation. Thus, in the determination of the oxidation-coefficient, p, five samples of pyrite and nine of marcasite were selected 'as being free from visible impurity and showing characteristic crystallization.' These fourteen samples served as the standards on which all following determinations of this coefficient have been based; apparently the same criteria were assumed in selection of the samples ground up for mixtures, in application of the process to calculation of the curve. But the visibility of impurities may have little value in their recognition, above all when the admixture becomes molecular. Even those samples, at the one extreme, selected for purity and mostly for perfection of crystallization, have revealed to Dr. Stokes, in the variations of p, the intermixture of one or of the other mineral, as well as of other impurities, in notable amount. At the other extreme (page 36 of his paper), out of 13 miscellaneous

specimens, six (Nos. 16, 19, 20, 22, 23 and 25) display paramorphic constitution, the amount of marcasite varying from 3 to 74 per cent.; this, too, notwithstanding that the intermixture is invisible, and that it presents the color and sometimes the crystalline form of one or the other mineral. The possibility of purity in some samples of pyrite had been shown in 12 specimens of my paper (page 204) and is confirmed by 5 out of 6 in another series of Dr. Stokes's (page 39); but even there the existence of paramorphism is proved by the last, No. 33, which, with at least the white color of marcasite, is found by Dr. Stokes to contain 83 per cent. of pyrite. Abundant evidence appears in both papers to prove the variation in intermixture in specimens of both minerals; the visibility of the impurity, when in the form of mechanical intermixture, as granules, films, etc.; and its invisibility when present, even in large amount, in molecular diffusion.

2. It is Dr. Stokes's view 'that the density affords no criterion of the composition,' in opposition to my statement that 'the latent constitution of these composite minerals is indicated by variation in density, exactly proportionate in most cases to the amount of each constituent.'

Further study of etched surfaces, described in my paper, had already led me, during the fourteen years since its publication, to recognize other conditions of structure and of composition which affect the density of pyrites, aside from the influence of their unquestionable intermixture. With the new evidence from Dr. Stokes's experiments, I am the more inclined to believe, at least, that these variations in density are caused by so many and such irregular conditions that they may not afford us reliable evidence as to the proportion of one, the marcasite impurity, in those specimens whose unusually low density, below 4.88, may indicate the influence of enclosures, cavities or abnormal composition. But the table of Dr. Stokes (page 39) has no bearing on this conclusion, since in specimen No. 28 the composition was not deduced from density, but, as in two others, from the abundant tarnish (page 204 of my paper), and Nos. 29 to 32 from abnormally low densities, 4.856 to 4.791; these were below that of marcasite, 4.88, as shown by Dr. Stokes, and therefore plainly due to enclosures of quartz, etc. The same objection disposes of the relevancy of the last four numbers in his table on page 13. All that is of present interest to science is the question whether there is any close relation between the true densities of the two minerals and those of their native specimens. Taking, then, from his tables all the specimens of both minerals of known densities which lie between these datum-points, and for which Dr. Stokes has ascertained the constitution by his chemical method, the following table presents the entire information on the subject now available. In the last column I have added the proportion of marcasite founded on density.

Nos.	Mineral.	Locality.	Density.	Marcasite Percentage.	
				Stokes.	Julien.
2, 3, 5	Pyrite.......	Col., Conn. and Utah..................	5.018, 5.023, 5.041	0	0
6	Marcasite....	Dover Cliffs, Eng.....................	4.881	100	99.5
7	" "	Galena, Ill...........................	4.891	100	92.2
9	" "	Linden Mine, Wis......................	4.901	100	84.9
10	" "	Galena, Ill...........................	4.886	100	95.8
11	" "	Hazel Green, Wis......................	4.896	100	88.5
12	" "	Weardale, Eng.........................	4.880	100	100
14	" "	Webb City, Mo.........................	4.887	100	95.1
23	" "	Crow Branch Mine, Wis..............	4.891	74	92.2
28	Pyrite.......	Galena, Ill...........................	5.015	0	0
33	Marcasite....	Cumberland, Eng......................	4.987	17	23.3

For this purpose, accepting Dr. Stokes's determination of the density of marcasite at 4.88, the formula given in my paper (page 178) would assume the form

$$x = \frac{17496}{a} - 3485,$$

in which x represents the percentage proportion of marcasite in the specimen under trial, and a the specific gravity of the specimen.

So far as these specimens go, there appears a fair approximation between the results of the chemical method and those founded on density, except in three cases (Nos. 9, 11 and 23), all from lead-mines in Wisconsin, in which Dr. Stokes detected the common enclosure of galenite, etc. Obviously the above series is not well chosen to afford a certain decision either way; only a series of crystallized specimens, with densities lying *between* the datum-points, 5.02 and 4.88, could be of service for satisfactory comparison. Therefore it appears to me that this second inference of Dr. Stokes also remains unproved.

The main object of my own paper in 1887, however, was the establishment of a principle of practical bearing and importance, in reference to roofing slate, coal and building-stone. This was the connection of the stability of the pyrites, whether marcasite or pyrite, in resistance to atmospheric agencies of decomposition, with the higher densities of these minerals, *i. e.*, in their ordinary forms of distribution in nature, apart from association with other sulphide-ores. It was there stated (page 222) that 'the highest stability can be expected only from samples of crystallized marcasite or pyrite whose specific gravity exceeds 4.99 * * * though little danger from decomposition may be expected down to a specific gravity 4.97.' This subject has not been considered in the paper of Dr. Stokes, has no necessary dependence on either of the purely hypothetical views already discussed, and the above conclusion, I believe, so far remains unquestioned.

Alexis A. Julien.

Columbia University.

COILED BASKETRY.

To the Editor of Science: May I say that no coiled basketry of any kind was made by the Indians of North America east of the Rocky Mountains? In the books there does not seem to be one illustration of coiled work taken from the surface of ancient pottery in this area. I am aware that in the Appalachians, and especially among the Cherokees, there is a kind of bread tray made of straw and sewed with wooden splints, after the old-fashioned beehive, but I am not positive that these are of pre-Columbian origin; second, that a little coiled work was done by the Comanches, but they are Shoshonean, and belong west of the Rockies; third, that the Mackenzie River hunting bags of babiche are coiled, but the makers are Athabascan; fourth, that the Central Eskimo make poor trinket baskets in coiled work which look dreadfully modern. With these facts in mind I am not prepared to say, without the permission of my colleagues, that the ancient tribes east of the Rocky mountains knew anything in the world about coiled basketry.

O. T. Mason.

THE MUD SHOWER.

Noticing in Science of May 2, p. 718, an account of a 'mud shower' at Easton, Pa., on April 12, by J. W. Moore, I wish to record the fact that a similar shower was observed at New Haven, Conn., on the same day, but between 4 and 5 P.M., instead of noon. White clothes hanging on lines in the yards were spotted in a very annoying way, every drop of rain leaving a mud-colored spot. The same kind of spots appeared on the window glass of houses. Ladies who attended the ball game that afternoon had their clothes badly spotted, showing that the shower here covered a considerable area, for the game was played on grounds in the suburbs. The shower was a slight one, of short duration, but every separate drop seemed to be charged with dirt. There had been showers of clean rain on the previous day. Is it not possible that the dirt was cosmic dust or of meteoric origin?

A. E. Verrill.

MAGNETIC DISTURBANCE AT TIME OF ERUPTION OF MONT PELÉE.*

COINCIDENT, as far as can be at present ascertained, with the time of eruption of Mont Pelée on May 8, a magnetic disturbance set in which was registered on the self-recording instruments of the two U. S. Coast and Geodetic Survey magnetic observatories, the one at Cheltenham, Md., seventeen miles southeast of Washington, and the other at Baldwin, Kansas, seventeen miles south of Lawrence. The preliminary reports received from Mr. L. G. Schultz, in charge of Cheltenham observatory and Mr. W. C. Bauer, in charge of Baldwin Observatory are sufficient to indicate that the disturbance began at practically the same instant of time at both observatories, viz., at 7h. 54m. St. Pierre local mean time. According to the newspaper reports the catastrophe befell St. Pierre about 8 A.M. of May 8 and it has been stated that the town clock was found stopped at 7h. 50m.

Purely mechanical vibrations caused by earthquakes are often recorded by the delicately suspended magnetic needles, as for instance the Guatemalan one which was felt at the Cheltenham Observatory on April 18 from about 9h. 20m. to 9h. 50m. P.M., 75th meridian mean time.

The disturbance on May 8, however, was distinctively a *magnetic* and not a seismic one and hence was not recorded on seismographs. The Cheltenham magnetograms exhibit magnetic disturbances amounting at times to .00050 to 0.00060 c. g. s. units (about 1/350 of the value of the horizontal intensity) and from 10′ to 15′ in declination, beginning at the time stated and continuing until midnight of the 9th. Even on the 10th tremors were still discernible. (At the time of writing the subsequent curves had not yet been received.)

Until further information has been received from other observatories, it cannot be determined definitely whether this magnetic disturbance was due to some cosmic cause or came from within the earth's crust and was associated with the Martinique eruption. The coincidence in time is however a remarkable fact.

L. A. BAUER.

U. S. COAST AND GEODETIC SURVEY,
May 17, 1902.

* Communicated by permission of Superintendent O. H. Tittmann, Coast and Geodetic Survey.

THE GUATEMALA EARTHQUAKE WAVES OBSERVED IN CANADA BY R. F. STUPART.

TO THE EDITOR OF SCIENCE: By permission of Professor R. F. Stupart, Director of the Meteorological Service of Canada, I send you herewith seismograms (Milne system) of April 18, local reckoning, recorded at Victoria, B. C., and Toronto, Canada; also a print of the magnetogram (bifilar trace) at Agincourt, nine miles from Toronto.

Each of these records the earth billows emanating from the region of the recent earthquake in Guatemala. Professor Stupart states that "the preliminary tremors began at Toronto 2 h. 30.5 m. A.M., April 19 of Greenwich mean time, and at Victoria 2 h. 31.3 m., G. m. t. Large waves began at Toronto 2 h. 35.5 m., but at Victoria 2 h. 37.2 m. The maximum wave occurred at Toronto 2 h. 38.0 m., but at Victoria 2 h. 50.7 m. The end occurred at Toronto 5 h. 24.0 m., but at Victoria about 5 h. 36.4 m. The amplitude at Toronto was over 25 mm.

FIG. 1. Record of Milne Seismograph, Toronto, April 18, 1902.

"In the magnetic observatory at Agincourt, nine miles from Toronto, the bifilar magnet began to swing at 2 h. 35.0 m., Greenwich mean time, and was at its maximum swing at 2 h. 44.4 m. Facsimiles of the records at Toronto, Victoria and Agincourt are given in the accompanying figures, Nos. 1, 2, 3, respectively."

C. A.

Washington,
May 7, 1902.

canaliculi in specimens injected in the laboratory of the late Professor Rutherford, of Edinburgh.

Some time ago the writer was at work on the vascular supply of the chief organs of vertebrates. In the course of these studies, many, probably fifty, injections were made with gelatine-carmine, well acidulated, of the livers of the rabbit, rat, cat and other mammals. The injection was made through the portal vein in every instance. The most painstaking

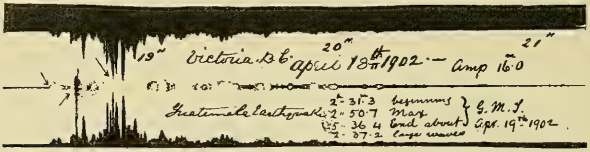

Fig. 2. Record of Milne Seismograph, Victoria, April 18, 1902.

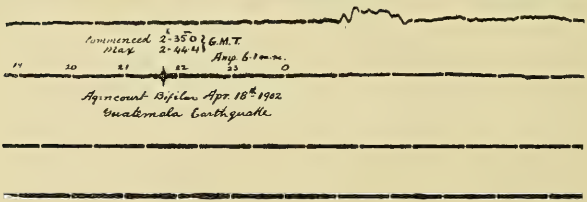

Fig. 3. Record of the Bifilar and other Magnets, Agincourt, April 18, 1902.

SHORTER ARTICLES.

INTRACELLULAR CANALICULI OF THE LIVER.

The cells of the liver in one of the higher vertebrates are characterized by activities at once numerous and diverse. It should not be surprising therefore if a specialized mode of communication were found between the hepatic cells and the blood capillaries with which they are related. Such a connection has, in fact, been predicted.

In a series of studies published from Cracow, Browicz has indicated grounds for believing that minute channels exist in the cells of the liver, and that these are continuations of the vascular system. More recently, Schaefer* has noted the presence of such

* Schaefer, E. A., *Anatomischer Anzeiger*, 1902, Bd. 21, S. 18–20.

precautions were always taken to secure the conditions which experience had shown to be necessary for proper injection, and some of the results were as nearly perfect as could be.

In sections made from successfully injected livers, the network of lobular capillaries is uniformly filled, there is no indication of extravasation, and the hepatic cells show no sign of distortion. In such specimens, exceedingly tenuous canaliculi may be seen within the cells, filled with the red injecting-mass, branching more or less, and anastomosing with each other. Under a high magnification, the blood capillaries do not present perfectly smooth walls, but exhibit minute, spine-like elevations at intervals. The connection between the intracellular canaliculi and the outpushings of the capillary wall may occasionally be seen with unmistakable definiteness. In fact, there can be hardly a doubt that the canaliculi constitute a series of fine twigs of the vascular system ramifying into the cytoplasm of the liver cells.

With such a direct relationship traceable between the interior of the cell and the stream of blood passing through the liver, it appears evident that the intracellular canaliculi noted must come to occupy a not unimportant place in our conceptions of hepatic functions. My only explanation as to why these structures have not been recorded before lies in the fact that injected material is usually examined only with low powers of the microscope.

GILBERT L. HOUSER.
LABORATORY OF ANIMAL MORPHOLOGY,
UNIVERSITY OF IOWA.

THE NICHOLS RESEARCH MEDAL OF THE AMERICAN CHEMICAL SOCIETY.

AT the first meeting of the New York Section of the American Chemical Society during the present session, the Secretary, Dr. J. A. Mathews, announced upon behalf of the executive committee that it was its intention to award a medal for chemical research, and to secure the necessary funds for the endowment of that medal in perpetuity and to raise a research fund from which grants might be made for the encouragement of scientific work. The executive committee became personally responsible for the award of the medal for the present year, and a committee on research fund and medal, with Dr. Maximilian Toch, chairman, was appointed. As the result of this movement, Professor Marston T. Bogert announced to the New York Section at its May meeting that Mr. William H. Nichols had conveyed to the American Chemical Society in trust for the New York Section, securities to the value of over $1,000 for the endowment of a medal to be given annually to the author of the best paper embodying original chemical research presented before the Section and subsequently published in the *Journal of the American Chemical Society*. It is not intended to limit this award to members either of the Section or of the Society at large, but to open the competition to all scientists.

Mr. William H. Nichols is a charter member of the American Chemical Society and is president of the General Chemical Company. In expressing its gratitude to Mr. Nichols the Section asked of him the honor of naming the medal 'The Nichols Medal of the New York Section.' Mr. Nichols, in acceding to this request, said that he did so in the hope that others would be induced to do likewise. Dr. Toch stated that other members and friends of the Section had contributed nearly enough to provide for the securing of an artistic design and die for this medal, for the annual presentation of which Mr. Nichols' generosity has provided.

*METEOROLOGY IN ARGENTINA.**

IT is well known that our countryman, Dr. B. A. Gould, of Cambridge, Mass., after having established an astronomical observatory in Argentina, turned his attention to climatology and inaugurated a meteorological office under the general directorship of Mr. Walter G. Davis, who had accompanied him from this country. After publishing about twenty annual volumes of meteorological observations and climatological investigations, Mr. Davis has now succeeded in realizing the great step in meteorology that has been taken by nearly every other climatological bureau. He has namely organized in Buenos Ayres, under the Argentine Department of Agriculture, a branch office that publishes a daily weather map based on telegrams from all available points. A recent letter from Mr. Davis states that "since the beginning of this year, I have had my time fully occupied in getting the daily weather may service organized; it is now fairly started, but far from being complete. We have free use of the national telegraph lines—as well as of nearly all the private railway wires—for the transmission of the 2 P.M. observations. At present there are nearly 70 stations sending in complete observations, and 350 pluviometric stations. Within the next few months I hope to have about 130 second class stations and a large increase in the rain-

* Prepared for the June number of the *Monthly Weather Review*.

reporting stations. The observations are sent here (Buenos Ayres) and the maps printed in our own establishment. The recent extension of the telegraph lines to the southern territories has been a great boon to us from a meteorological point of view; the coast line is now at Rio Gallegos in Santa Cruz, and another branch is being constructed near the foot of the Cordilleras from latitude 38 to 47 degrees south and then crosses the country to the Atlantic coast. This is a most important line for us, as it will give us communication with the region where nearly all the 'pamperos' have their birth and development.

"No attempt has been made at forecasting, as I consider it better to have some experience with the conditions, as shown by the daily maps before undertaking to do too much; I trust however that his branch of work will come in due time."

The daily map published by the meteorological office at Buenos Ayres makes a very imposing appearance. It is 16.2 inches high by 11.1 broad and extends between the 46th and 77th degree of longitude west from Greenwich and between the 21st and 57th degree of south latitude. This region, in the Southern Hemisphere, corresponds to a portion of the Northern Hemisphere, extending north and south, between Turks Island, Bahamas, and Maine, Labrador, and east and west between Washington, D. C., and Cape Farewell. When this large region in the Southern Hemisphere shall have had its storms and 'pamperos,' its isobars and isotherms thoroughly studied, we shall feel that a great advance has been made in the meteorology of the globe.

We are not informed whether the daily weather map of the Province of Buenos Ayres, published for ten years past by the Observatory at La Plata, will be discontinued—but evidently the much more comprehensive work of the general Department of Agriculture must supersede that.

The elaborate presentation of Argentine climatology, compiled by Dr. Davis for the official volume of statistics of that Republic is about to appear in Spanish and English text, as a special treatise by him, on the climate of that region. The climatology of Dr. Davis and his new daily weather map show that the meteorology of the South Temperate Zone of America is in excellent hands.

SCIENTIFIC NOTES AND NEWS.

The retirement of Surgeon-General Sternberg will be made the occasion of a dinner to be given in New York City on June 13. Those wishing to express their appreciation of Dr. Sternberg's great services to the army, to the medical profession and to science by attending the dinner should address Dr. Hermann H. Biggs, 5 West 58th Street, New York City.

Dr. Roswell Park, director of the State Pathological Laboratory at Buffalo, will give the annual address before the Medical School of Yale University at the approaching commencement.

The Geological Society of London has elected as foreign correspondents Professor T. C. Chamberlin, of the University of Chicago; Professor S. W. Williston, just called to the University of Chicago, and Dr. T. Thoroddsen, of Iceland.

The Linnean Society of London has elected as foreign members Professors C. S. Sargent, F. E. Schultze, J. Wiesner, H. J. Hansen and A. Giard.

The Liverpool Biological Society gave a complimentary dinner to Professor W. A. Herdman on the occasion of his return from investigating the pearl oyster fisheries of Ceylon.

M. T. Moureaux succeeds the late M. Renou as director of the magnetic observatory in the Parc Saint-Maur.

The Rede lecture at Cambridge University will this year be given by Professor Osborne Reynolds, F.R.S., his subject being 'On an Inversion of Ideas of the Structure of the Universe.'

Dr. Thomas L. Watson, of Denison University, will continue field work during the coming season on the manganese and ochre deposits of Georgia, for the Geological Survey of Georgia.

DR. HERM. JORDAN, formerly assistant in the Zoological Station, Naples, has gone to Zurich as assistant in the Concilium Bibliographicum.

PROFESSOR JOHN H. KINEALY, head of the department of mechanical engineering at Washington University, in St. Louis, has resigned to engage in private practice.

DR. S. W. WILLISTON, whose call to the chair of paleontology in the University of Chicago we announced last week, will also have charge of the paleontological collections in the Field Columbian Museum.

THE Council of the Geological Society of America has recommended candidates for election as fellows: Frank M. Anderson, B.A. (Stanford, '95), M.S. (Univ. of Cal., '97), Berkeley, Cal.; Ernest Robertson Buckley, B.S., Ph.D. (Univ. of Wis., '98), Rolla, Mo., state geologist and director of Bureau of Geology and Mines; Arthur J. Collier, A.B., A.M. (Univ. of Oregon), S.B. (Harvard), Washington, D. C., assistant geologist U. S. Geological Survey; John Burchmore Harrison, M.A. (Cambridge, England), F.I.C., F.G.S., Georgetown, Demerara, Brit. Guiana, government geologist; Edward Henry Kraus, B.S., M.S. (Syracuse, '97), Ph.D. (Munich, '01), Syracuse, N. Y., associate professor of mineralogy, Syracuse University; George Davis Louderback, A.B., Ph.D. (Univ. of Calif., '96 and '99), Reno, Nev., professor of geology, University of Nevada; George Curtis Martin, B.S. (Cornell), Ph.D. (Johns Hopkins), Baltimore, Md., assistant in paleontology, Johns Hopkins University, has been assistant geologist on the Maryland Geological Survey; Walter Curran Mendenhall, B.S. (Ohio Normal Univ.), Washington, D. C., geologist, U. S. Geological Survey; George Henry Perkins, A.B., Ph.D. (Yale, '67–'69), Burlington, Vt., professor of geology, University of Vermont, state geologist; William Sidney Tangier Smith, B.L., Ph.D. (Univ. of Calif., '90–'96), Washington, D. C., assistant geologist, U. S. Geological Survey; Alfred William Gunning Wilson, A.B. (Toronto), A.M., Ph.D. (Harvard, '01), Cobourg, Ontario, Can., geologist, temporary staff, Geological Survey of Canada.

DR. JOHN ALEXANDER MATHEWS, of Columbia University, has been informed by the secretary of the Iron and Steel Institute of Great Britain that 'by the unanimous vote of the president and council the first Andrew Carnegie Gold Medal for research' had been awarded to him on May 8. Dr. Mathews has held the university fellowship in chemistry and has three times been awarded the Barnard fellowship for the encouragement of scientific research, both by Columbia University A year ago the Carnegie research scholarships of the Iron and Steel Institute were awarded to Dr. A. Stansfield, of London; Mr. Julius Goldberg, an Austrian; and to Dr. Mathews. At the meeting of the Institute held in London, May 7 and 8, his paper entitled, 'A Comparative Study of Some Low Carbon Steel Alloys,' was presented and for it the medal was awarded. Mr. Carnegie was so well pleased with the result of his original endowment that he has doubled his gift for next year with the result that six research scholarships have been awarded for the coming year. Three of these were awarded to English metallurgists, one to a Parisian, one to a resident of Berlin and the sixth to Mr. William Campbell, an Englishman, who is at present studying with Professor H. M. Howe. Mr. Campbell is an 1851 exhibition scholar and fellow-elect in metallurgy at Columbia University. Mr. Campbell and Dr. Mathews worked together with Professor Sir William Roberts-Austen and later with Professor Howe, and Mr. Campbell's appointment to the Carnegie scholarship is made with the understanding that he continue researches upon low carbon steel alloys.

THE centenary of the birth of the Norwegian mathematician, Niels Henrik Abel, will be celebrated at Christiania in September. Abel was born in 1802 and died at the early age of twenty-seven years, but in this short period attained rank among the foremost mathematicians of the century.

MR. JEFFERSON CHASE, the well-known inventor, died in Portland, Me., on May 20. Mr. Chase, his father, brother and son, made many inventions, including a circular saw, a water wheel, wood pulp pails, etc.

MR. C. HENRY WERNLE, a maker of mathematical instruments at the U. S. Arsenal at Frankfort, died on May 20, aged seventy-one years.

MR. GEORGE GRIFFITH, the assistant general secretary of the British Association for the Advancement of Science, and formerly science master of Harrow School, died on May 7, at the age of sixty-eight. Mr. Griffith had been connected with the British Association for over forty years, having first acted as local secretary in 1859 for the Oxford meeting. An English correspondent writes: "Mr. Griffith's death will be keenly regretted by the members of the Association, with whom his relations were most courteous, he being, as is needful in that position, one of those who 'suffer fools gladly.' His death was unexpected. He died in harness."

DR. G. MONRO GRANT, since 1887 principal of Queen's College, Kingston, a well-known Canadian educator and author, died on May 11, at the age of sixty-seven years.

THE fourteenth annual meeting of the Association of Economic Entomologists will be held in Pittsburgh, Pa., on Friday and Saturday, June 27 and 28. Sessions will be held in the west room of Carnegie Lecture Hall, Carnegie Institute, Schenley Park. The opening session will convene on Friday at 10:00 o'clock A.M. Members are requested to send titles of communications, which they may desire to present, as soon as possible to the secretary, Professor A. L. Quaintance, College Park, Md.

THE Royal Society of Canada is this week holding its annual meeting at Toronto, the exercises being on May 27, 28 and 29. They include the address by the president, Dr. James Loudon, president of the University of Toronto and professor of physics, whose subject is 'Universities in Relation to Research,' and a popular science lecture by Dr. Jeffrey, of the University of Toronto, on 'The Forest Trees of Canada.' The Society meets in four sections, one devoted to French literature, one to English literature, one to the mathematical, physical and chemical sciences and one to the geological and biological sciences.

IN connection with the proposal to enlarge the Royal Society so as to include representatives of the historical, philological and moral sciences, or to establish a new academy for these sciences, Mr. Charles Waldstein, of King's College, Cambridge, has proposed the establishment of an Imperial British Academy of Arts and Sciences, which would include four sections as follows: The Royal Society for the natural and mathematical sciences, a new Royal Society of Humanities for the historical, philological and moral sciences, the present Royal Academy for painting, sculpture, architecture and the decorative arts, and a new Royal Academy of literature and music.

WE have noted that a commission is considering the question as to whether a state electrical laboratory should be established in New York state, to provide means for testing electric measuring instruments. Of this proposal the *Electrical World and Engineer* says: "We sincerely hope that no such state laboratory will be established, as it would be worse than useless expense. The Bureau of Standards at Washington is a national body, charged with doing this precise work among other duties. There is no immediate likelihood of this bureau being so far overwhelmed with electrical work as to be incapable of supplying the demand. No sub-standardizing bureaus should be called into official existence without being annexed to the National Bureau at Washington. A number of state electric standardizing bureaus are likely to lead to just as many different values of the volt, ampere and watt, besides involving much reduplicated labor and expense. Were the states generally to indulge in the practice, the situation might become particularly unbearable to the manufacturing companies doing business all over the country."

THE botanical laboratories, presented to University College, Liverpool, by Mr. W. P. Hartley, were opened by Sir William Thiselton-Dyer, F.R.S., on May 10 last.

BEFORE the Zoological Society of London on May 6 Mr. Oldfield Thomas, F.R.S., read a paper on the 'Mammals obtained during the

Whitaker Expedition to Tripoli. At Mr. J. I. S. Whitaker's expense Mr. E. Dodson had made a successful collecting expedition into Tripoli, and the specimens of mammals obtained had been presented to the National Museum. Twenty-one species were referred to, and, among others, a Hare (*Lepus whitakeri*), allied to *L. æthiopicus*, but of a bright pinkish buffy color, and a Gundi (*Ctenodactylus vali*) like *C. gundi*, but with much larger bullæ, were described as new.

WE learn from *Nature* that a meeting of delegates representing a number of natural history and photographic societies was held at Croydon on Friday, May 9, Mr. W. W. Whitaker, F.R.S., being in the chair, to consider and set in motion a photographic survey of Surrey. It was resolved that a society be formed to be called 'The Photographic Survey of Surrey,' and that its object be to preserve a record in permanent photographs of buildings of interest, antiquities, scenery, geology, natural history, anthropology, and of portraits of notable persons, representations of passing events of local or historical importance, and of old records, rare books, prints, maps, so as to give a comprehensive survey of what is valuable and representative in the county of Surrey.

AT a meeting at the Mansion-house on May 18 the Duke of Devonshire, as reported in the *Times*, spoke as follows concerning the conditions which have to be complied with before incorporation of University College with the University of London can take place: The value of the site, buildings, and equipment to be transferred under the scheme provisionally settled between the authorities of the college and the senate of the university is estimated at £500,000, and in addition the administration of the income of certain trust funds, which amount to nearly £300,000, will pass to the university. In order to make the transfer effectual certain preliminary conditions were required: (1) The extinction of the debt upon the college, which has been accomplished by a gift of £30,000 from the Drapers' Company. (2) The removal of the University College School, an institution of a secondary type, in order to obtain the needful accommodation for university teaching and research, the cost of which is estimated at £60,000. (3) An arrangement by which separate provision, including class-rooms, laboratories, and a pathological museum, can be made for advanced medical studies in order to place the school of medicine on a proper footing, which is calculated to cost another £40,000. Towards this sum of £100,000, which is the immediate object of the appeal, £30,000 have been given by an anonymous donor, and there are other sums promised to the extent of £15,000. On the remaining £55,000 being raised and the college placed at the disposal of the university, the £20,000 offered by Mr. Astor for the increase of the endowment of chairs becomes immediately available for university purposes, and the university will also assume direct administration of that part of the contribution of the Technical Education Board which it has hitherto entrusted to the college. Later and at far greater cost, as the funds at the disposal of the university increase, it is hoped that further advantage will be taken of the opportunities presented by the acquisition of the college for the development of higher education. Schemes for the completion of the west wing, to include the space required for engineering, applied mathematics, physiology and chemistry, are in contemplation, and other changes that would give sufficient accommodation to the departments of zoology, anatomy and physics and also provide a library of adequate dimensions. For the present, however, two great objects will be gained by the success of the appeal for £100,000: (1) A fuller utilization of the resources of the college as an establishment for the promotion of advanced studies; and (2) the provision for the university, which has as yet done little but create administrative machinery, of the means of entering fairly well equipped upon the twofold mission of instruction and research.

UNIVERSITY AND EDUCATIONAL NEWS.

MR. ISAAC H. CLOTHIER, of Philadelphia, has offered $100,000 to Swarthmore College on condition that an endowment fund of $600,000 be collected. It is reported that the further sum of $250,000 has been subscribed.

Wesleyan University has received an anonymous gift of $75,000 for the erection of a new science building.

In addition to the gift of $50,000 from Mr. D. O. Mills, noted last week, the University of California has received about $20,000 for the purchase of books from Mrs. Phoebe Hearst, Mrs. Jane K. Sather and Mr. Claus Spreckels; $5,000 for a lectureship in the College of Commerce from Mr. Henry Weinstock, and $8,000 for a chair in physiology from Dr. M. Herzstein.

The Secretary of the Navy was authorized in 1900 to complete plans for new buildings and improvements for the Naval Academy at Annapolis at an expense not exceeding $8,000,000. We learn from the report of the House Committee on Naval Affairs that the armory and the boat-house are nearly finished and the foundations of the marine engineering building are being constructed, the expenditure so far amounting to nearly $1,200,000. The contract has been let for the cadets' quarters, which will cost $2,248,000, accommodating 1,200 cadets. The gymnasium and officers' quarters will be under contract by June 1, as will also be the building known as the officers' mess, and plans for the sea-wall work are now practically completed and will be advertised in a short time.

Miss Margaret F. Washburn, Ph.D. (Cornell), has been elected to the professorship of psychology in the University of Cincinnati vacant by the removal of Professor Judd to Yale University. Miss Washburn is at present warden of the women's college at Cornell University and will occupy a similar position at Cincinnati.

Dr. Arthur Lachman has resigned the chair of chemistry and the deanship of the College of Science and Engineering in the University of Oregon.

Dr. John H. Washburn has resigned the presidency of the Rhode Island College of Agriculture and the Mechanic Arts at Kingston.

Professor David Franklin Houston, professor of political science in the University of Texas, has been elected president of the Texas Agricultural and Mechanical College at Bryan.

The board of governors of McGill University has appointed Dr. Wyatt Johnson, assistant professor of hygiene, to be professor of hygiene, in succession to Dr. Craik. The following appointments of demonstrators have also been made: Alfred W. G. Wilson, Ph.D., in geology; Mr. Howells Frechette, B.Sc., in metallurgy; Mr. K. M. Cameron, B.Sc., in civil engineering; Mr. H. A. Burson, M.Sc., and Mr. E. L. Franklin, B.Sc., in electrical engineering.

Appointments at Yale University have been made as follows: L. F. Rettiger, to be instructor in bacteriology; Andrew L. Winter, instructor in organic analysis; and Arthur L. Dean, assistant in plant physiology.

Dr. William B. Huff, now assistant in physics at Johns Hopkins University, has been appointed associate in physics at Bryn Mawr College.

H. L. Rietz, assistant in mathematics at Cornell University, has been appointed to fill the chair of mathematics at Butler College.

The following appointments have been announced at Cornell University: E. J. McCaustland, assistant professor in civil engineering; Herman Diedrichs, assistant professor in experimental engineering; Dr. Ernest Albee and Dr. Albert Lefevre, assistant professors in philosophy, and Dr. I. M. Bentley, assistant professor in psychology. In the department of Professor Wilder, Mr. Hugh D. Reed has been promoted from assistant to instructor in systematic and economic vertebrate zoology, and the graduate scholarship in neurology has been for the second time assigned to Mr. Thomas L. Hankinson.

Professor H. S. Pratt, of Haverford College, formerly a student in the Zoological Laboratory of Harvard University, is to be abroad next year on leave of absence. His place is to be filled during his absence by R. M. Strong, Ph.D. (Harvard University, 1901).

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.

JUNE 6, 1902.

CONTENTS:

*THE IONS OF ELECTROLYSIS.**

THE subject of electrolysis must always have a special interest for the Royal Institution. It was here that Davy showed its practical value by his brilliant discovery of the metals of the alkalies and alkaline earths; and it was here that Faraday laid the foundation of the scientific discussion of electrolysis; it was here that with his singular experimental skill and clearness of insight he discovered and expounded the laws of electrolysis which will always be known by his name. It is therefore with a good deal of diffidence that I stand here to continue the story. And there is much to be said, for, like all good work, Faraday's work has been fruitful, and in consequence of it, as well as of the genius and skill of subsequent investigators, we now know much about electrolysis which Faraday did not and could not know.

The great difficulty left was that of the mechanism of electrolysis. That the cation and the positive electricity travel together towards the cathode, and that the negative electricity similarly travels with the anion towards the anode, and that on their arrival at the electrodes the electricity is delivered to the metallic conductor and the matter is set free to appear as the ion itself, or to break up, or to act on the elec-

* Lecture given before the Royal Institution of Great Britain.

trode, or on the solvent, or on something present in the solution; that the quantity of each ion so set free is proportional to the quantity of electricity transferred from the one electrode to the other and to the equivalent of the ion—that is, as we would put it now (if purists will allow us to speak of the *atomic* weight of NH_4 or of NO_3), to the atomic weight of the ion divided by its valency; all that was made out by Faraday. He had made some way in finding out how the liberated ions act, when they do act, on the things in the presence of which they find themselves; and where he led, others have followed, so that we have now many electrolytic methods of oxidation, of reduction and of synthesis, and great manufacturing industries depending on electrolysis. On this large field I do not now purpose to enter. What I wish to call your attention to this evening is the mechanism of electrolysis, or perhaps I should say the progress that has been made towards an explanation of the phenomena.

The earlier theories, from Grotthuss* in 1806, all assume that the decomposition is caused by the attraction of the electrodes or by the passage of the current, and that a definite electromotive force, different for each electrolyte, is required in order that decomposition shall take place. According to these theories, if the electromotive force is below that definite minimum no decomposition can occur and no current can pass.

And indeed at one time it was supposed that this was so. But Faraday, in a series of ingeniously devised and carefully executed experiments, showed that with electromotive force below the minimum necessary for the production of bubbles of gas on the electrodes, a perceptible current could pass for many days. He supposed that this small current was due to non-electrolytic conduction by the electrolyte. But the study of the phenomena of the polarization of the electrodes led ultimately to the complete explanation by Helmholtz* in 1873 of this apparently metallic conduction by the electrolyte, and to a proof that any electromotive force, however small, sends a current through an electrolyte and gives rise to separation of the ions proportional to the amount of electricity transmitted.

The phenomena of the polarization of the electrodes may be described shortly as follows: In the electrolysis of water (or rather of dilute sulphuric acid) it had been observed so long ago as 1802 that platinum or silver plates which had been used as electrodes acquired peculiar properties, so that for a short time the plate that had been the anode acted like the silver, and the plate that had been the cathode like the zinc of a voltaic cell, producing a short-lived and rapidly diminishing current. This observation was first made by Gautherot,† a teacher of music in Paris, who notes the effect of the current on the tongue and states that he had succeeded in decomposing water by means of his apparatus. Shortly after, J. W. Ritter, apparently without knowing anything of Gautherot's work, made a great many observations on the same subject. I cannot refrain from reading to you a passage from a letter from Christoph Bernoulli to van Mons. I take it from the translation published in *Nicholson's Journal*, October, 1805: "As Mr. Ritter at present resides in a village near Jena, I have not been able to see his experiments with his grand battery of two thousand pieces, or with his battery of fifty pieces, each thirty-six inches square, the action of which continues

* Grotthuss, *Annales de Chimie*, LVIII., p. 54 (1806).

* Helmholtz, *Pogg.*, 150, p. 483 (1873); Faraday Lecture, *Chem. Soc. Trans.*, 39, p. 287 (1881); *Wied.*, 34, p. 737 (1888).

† Gautherot, *Annales de Chimie*, XXXIX., p. 203 (1801).

very perceptible for a fortnight. Neither have I seen his experiments with the new battery of his invention, consisting of a single metal, and which he calls *the charging pile*.

"I have frequently, however, seen him galvanize louis-d'or lent him by persons present. To effect this, he places the louis between two pieces of pasteboard thoroughly wetted, and keeps it six or eight minutes in the chain of circulation connected with the pile. Thus the louis becomes charged, without being immediately in contact with the conducting wires. If this louis be applied afterwards to the crural nerves of a frog recently prepared, the usual contractions will be excited. I had put a louis thus galvanized into my pocket, and Mr. Ritter said to me a few minutes after, that I might find out this louis from among the rest, by trying them in succession upon the frog. Accordingly I made the trial, and in reality distinguished among several others a single one in which the exciting quality was very evident. This charge is retained in proportion to the time that the piece has remained in the circuit of the pile. It is with metallic discs charged in this manner, and placed upon one another with pieces of wet pasteboard alternately interposed, that Mr. Ritter constructs his charging pile, which ought, in remembrance of its inventor, to be called the *Ritterian pile*. Mr. Ritter made me observe that the piece of gold galvanized by communication exerts at once the action of two metals, or of one constituent of the pile; and that the half which was next the negative pole while in the circle became positive, and the half toward the positive pole became negative."

Brugnatelli* suggested that the polarization of the plate which during the electrolysis had given off hydrogen was due to a compound of hydrogen with the metal of the electrode. But it was not until Schönbein discussed the question in 1839* that a systematic attempt was made to settle it by experiment. Schönbein's results were in favor of the view that the polarization is due to the formation on the surfaces of the electrodes of thin sheets of the products of the electrolysis.

Now the old theories assume that if we begin with very small electromotive force and gradually increase it, we have at first a state of tension, the electromotive force, so to speak, pulling at the ions, that this tension increases as the electromotive force increases till it becomes sufficient to pull the ions apart. If this were so there should be no current and no electrolysis till the electromotive force reaches a certain amount, and then suddenly a very great current and something like an explosive discharge of gas; for many molecules would be in the very same state of tension and all would give way at once.

When the electrolytic decomposition of water was first observed, as it was (by Nicholson and Carlisle) immediately after the publication of Volta's first description of the pile, the great difficulty felt by every one was that the hydrogen and the oxygen came off at different places which might be far apart. Grotthuss's theory no doubt explained this, but after the proof of a cause of polarization given by Schönbein, and the accumulating evidence that Ohm's law applies to electrolytic as well as to metallic conduction, no one could hold or defend Grotthuss's theory, although it was retained as a sort of makeshift until some one could think of something better. The something better was produced by Clausius in 1857.† Clausius was one of the eminent physicists to whom we owe the

* Brugnatelli, *Gilbert's Annalen*, XXIII., p. 202 (1806).

* Schönbein, *Pogg.*, XLVI., p. 109; XLVII., p. 101 (1839).

† Clausius, *Pogg.*, ci, p. 338 (1857).

kinetic theory of gases, and his theory of electrolysis is derived from an application to solutions of the ideas involved in this kinetic theory. He supposes that the molecules of the electrolyte move through the solution as the molecules of a gas move, that they collide with one another as the gas molecules do, and that it must happen that here and there ions get separated and remain separated for a time, cation again uniting with anion when two of them meet under favorable conditions. There will thus always be some detached ions moving about just as molecules do. They will not always be the same ions that are thus detached, and a very small proportion of such loose ions will suffice to explain the phenomena. These loose ions retain in their separate condition the charges of electricity which they had when united, the cations being positively and the anions negatively charged. This is assumed to be the state of matters in any solution of an electrolyte. If now into such a solution we place two electrodes with any, however small, difference of potential, the cathode, being negative, will exercise an attraction upon the positively charged cations, and the positive anode will exercise a similar attraction on the negatively charged anions, and thus the loose ions, which before the introduction of the electrodes moved about in the liquid with no definite preferred direction, will on the whole, now that the electrodes have been introduced, move preferably, the cations towards the cathode, and the anions towards the anode, and those which are near the electrodes will be drawn to them and discharge their electric charge. This theory seems therefore to explain the phenomena. The essential difference between it and all previous theories is that Clausius does not attribute the decomposition to the current or to the attraction of the electrodes; what the attraction of the electrodes does is to separate the ions already disengaged from one another, and this the smallest electromotive force can do. The theory is so far adequate, but is it admissible? Can we suppose that hydrogen and chlorine atoms can move uncombined through the solution? It is to be noted that while Clausius does not give any opinion as to the proportion of loose ions to the total ions in any case, he assumes that this proportion increases as the temperature rises, on account of the greater briskness of the movements of the particles, and points out that this is in accordance with the fact that electrolytes conduct better as the temperature is higher. But he says, 'to explain the conduction of the electricity it is sufficient that in the encounters of the molecules an exchange of ions should take place here and there, and perhaps comparatively rarely.'

In this connection we may look at the views expressed by Williamson in his paper on the theory of etherification.* He says: "We are thus forced to admit that in an aggregate of molecules of any compound there is an exchange constantly going on between the elements which are contained in it. For instance, a drop of hydrochloric acid being supposed to be made up of a great number of molecules of the composition ClH, the proposition at which we have just arrived would lead us to believe that each atom of hydrogen does not remain quietly in juxtaposition with the atom of chlorine with which it first united, but, on the contrary, is constantly changing places with other atoms of hydrogen, or, what is the same thing, changing chlorine." Williamson founded this opinion on the observed facts of double decomposition. He made no application of this view to the case of electrolysis, and indeed does not explicitly mention the temporary detachment of the atoms during the process of ex-

* Williamson, *Chem. Soc. Journ.*, IV., p. 111 (1852).

change; this is wholly due to Clausius, who arrived at his views as to the exchanges going on in a solution in a way quite different from that followed by Williamson, and quite independently. It was not then known how closely double decomposition and electrolysis are connected. We may perhaps get a clearer idea of Clausius's theory by imagining the phenomenon to take place on a scale such that we could see the individual ions. Let us then imagine a large field with a large number of men in it, each mounted on a horse. We shall further suppose that all the men are exactly alike and that all the horses are exactly alike. They are moving at random, most of them at about the same rate, but a few of them faster, a very few of them considerably faster, a few of them slower, a very few of them considerably slower, than the average. They move in straight lines until they meet an obstacle which makes them deviate. This obstacle will often be another man and horse. The collision will give both a shake, and will sometimes dismount one or both of the riders. When this happens each will look for a horse, and as all horses are exactly alike, the horse such a dismounted man finds and mounts will not always be the one he came down from. But in any case there will be always in the field some men without horses and some horses without men. And the quicker the average pace the larger will be the proportion of dismounted men and riderless horses to the total number of men and horses. And this not only because there will be more and, as a rule, more violent collisions, but also because the dismounted men will have more difficulty in catching horses, although to keep up the analogy of the ions we must suppose the horses to be as anxious to be caught as the men are to catch them. If it does not make my allegory too grotesque we might suppose places with attractions for men and for horses, respectively, to correspond to the electrodes, so that a man looking for a horse would on the whole rather go in the direction of lunch than away from it, and if he got near the refreshment room before he found a horse, he would look in there. An objection was made to Clausius's theory that the same thing which he supposed to happen in solution, say of hydrochloric acid, ought also to happen in the gas. We are not yet in a position to discuss this point with much prospect of obtaining a perfectly satisfactory explanation of the difficulty, although some progress towards an intelligible theory has been made, but at the risk of being tedious I may indicate that my allegory may show us that we need not despair of finding in due time an answer. Let us suppose that in the field there are not only men and horses, but also a large number of other moving objects, let us say, by way of example, cows. It seems plain that whether the presence of the cows would increase the chance of a man being dismounted or not, it would sensibly interfere with his chance of catching a horse if he were. And it will be admitted that the nature and size of these other moving objects must exercise an influence on the proportion of horseless men and riderless horses to the total number. But these other moving objects represent the molecules of the solvent, so that we need not be surprised when we find that the electrolytic conductivity is affected by the nature of the solvent and that where there is no solvent the conductivity is very small or even nothing.

A very important question was left only partially answered by Faraday. It is, What substances are electrolytes? Faraday considered the water in dilute acid as the electrolyte, and the acid as a substance having the power of increasing the conductivity of the water. When a solution of sulphate of copper was electrolyzed, he supposed that the water was primarily decomposed and that the metallic copper was a secondary product reduced by the nascent hydrogen. He says:* "I have experimented on many bodies, with a view to determine whether the results were primary or secondary. I have been surprised to find how many of them, in ordinary cases, are of the latter class and how frequently water is the only body electrolyzed in instances where other substances have been supposed to give way." From our present point of view many of us would rather say that the direct electrolysis of water very rarely occurs, except to a very small extent.

In 1839 Daniell began a series of ingeniously devised and skillfully executed experiments with the view of determining, in the case of salt solutions, whether it is the salt or the water which is primarily electrolyzed. The results appeared in two letters from Daniell to Faraday in 1839† and 1840,‡ and in a paper by Daniell and W. A. Miller in 1844,§ all published in the *Transactions of the Royal Society.* The purpose of these investigations was attained, and it was completely proved that in reference to their behavior as electrolytes there was no difference between say potassium chloride and potassium nitrate, except that in the latter some ammonia was formed at the cathode by the reducing action of the nascent hydrogen, and it was clearly shown that from an electrolytic point of view all the oxygen acids and their salts fell into line with hydrochloric acid and the chlorides, and the NH_4 was electrolytically perfectly analogous to K. There is, however, an interest in these papers beyond this important result. In the earlier part of the work the authors measured the amount of electrolysis not only by 'the amount of ions disengaged at either or both electrodes by the primary action of the current or the secondary action of the elements,' but also tried to obtain a check to this way of measuring, by using a diaphragm in the electrolytic cell, and analyzing the contents of the two parts of the cell, the one on the anode side and the other on the cathode side of the diaphragm. This check was 'founded on the hypothesis that the voltaic decomposition of an electrolyte is not only effected by the disengagement of its anion and cation at their respective electrodes, but by the equivalent transfer of each to the electrodes, so that the measure of the quantity of matter translated to either side of the diaphragm might be taken as the measure of the electrolysis.' They soon found that this hypothesis was unfit to give any such measurement, and in the paper of 1844 state that their results show that the hypothesis of equivalent transfer of the ions, 'although generally received, is itself destitute of foundation.'

The non-equivalent transfer of the ions, incidentally observed by Daniell and Miller, and imperfectly measured by them in a few cases, was made the subject of a long and elaborate series of experiments by Hittorf. The work extended over six years from 1853 to 1859* and is a monument of patient labor and of happy adaptation of means to a clearly perceived end. The importance of the work was not at first recognized by either physicists or chemists; indeed its meaning was scarcely understood. I shall try to put before you as shortly as I can an outline of the ideas involved in the work, and of the most important conclusions arrived at by Hittorf. As the anions and the cations are separated at their re-

* Faraday, 'Experimental Researches in Electricity,' par. 751 (1834).

† Daniell, *Phil. Trans.*, 1839, p. 97.

‡ *Op. cit.*, 1840, p. 209.

§ Daniell, *Phil. Trans.*, 1839, p. 97.

* Hittorf, *Pogg.*, LXXXIX., p. 177 (1853); XCVIII., p. 1 (1856); CIII., p. 1 (1858); CVI., pp. 337 and 513 (1859). *Arch. Néerland.* (II.), VI., p. 671 (1901).

spective electrodes in equivalent quantity, that is, in the case where the valency of anion and cation is the same, in equal numbers, it never occurred to any one to doubt that they traveled towards the electrodes at the same rate, until Daniell and Miller showed that this hypothesis is erroneous. To follow their reasoning and that of Hittorf we may take an imaginary case, and suppose an electrolyte MX with its cation M and its anion X of such character that these ions when separated at the electrodes can be removed from the solution completely and at once, and that the electrolysis is carried on in a vessel provided with two compartments, one containing the cathode and the other the anode, such that whatever happens at an electrode shall affect only the contents of the compartment containing that electrode, and so arranged that the liquid contained in each compartment can be completely removed from it and analyzed. Now, let us first suppose MX to be such that its ions travel at the same rate. In the time then in which one M has entered the cathode compartment one X has left it. There is at this moment an excess of two M's in this compartment; these are deposited at the cathode, and now the concentration of the solution in this compartment is diminished by one MX. Similarly at the anode during the same time one X has entered and one M has left, two X's have been deposited and the solution has lost one MX. In this case, then, where the two sets of ions travel at the same rate, the loss of solute is the same at the two electrodes. Let us now suppose an extreme case in which one of the sets of ions (say the cations) does not travel at all. In the time in which one X leaves the cathode compartment no M enters it, the excess of one M is deposited, and the solution here has lost one MX. At the anode one X has entered and no M has left, the X is deposited, and the solution here has lost no MX. Again, take the case that the anions travel twice as fast as the cations. Here in the time in which one M enters the cathode compartment two X's leave it, the excess of three M's is deposited, and the solution has lost two MX's. At the anode during the same time one M has left and two X's have entered, the three X's have been deposited and the solution has lost one MX. Of course it will be seen that the excess of one kind in a compartment consists not only of what enters it, but also of the excess resulting from the departure of the other kind. Without taking any more cases we at once see that the speed of the cation is to that of the anion as the loss of solute at the anode is to that at the cathode. This non-equivalent transfer has sometimes been described in another way. It has been said that the ions go at the same rate, but that at the same time the solute as a whole is being moved towards one of the electrodes. But this really is the same thing. If we imagine two processions walking with the same length of step and the same number of steps a minute in opposite directions on such a moving platform as that in the Paris Exhibition, we might no doubt say that the two *walked* at the same rate; they could not be said to *travel* at the same rate. Hittorf's way of putting it is not only the simpler way, it is the only way that agrees with what has since been made out as to the rate of movement of the ions.

Hittorf's work had to wait long for recognition, but we now know its great importance, not only on account of the large number of accurate measurements, but also because of the general conclusions he drew from them. He deduced from the transfer numbers conclusions as to the nature of the solute, showing, for instance, that solution of stannic chloride electrolyzes as hydrochloric acid, the stannic chloride being completely hydrolyzed. He also showed that such double salts as KCN,AgCN, 2KCl,-

$PtCl_4$ and $KCl,AuCl_3$ have potassium for their only cation, the silver, the platinum and the gold forming part of the anion. He also showed that $2KI,CdI_2$ behaves as a single salt with K as cation when the concentration is great, but as two salts with cadmium as well as potassium as cation in dilute solution. In these and in similar cases, Hittorf made a valuable contribution to the theory of double salts. But perhaps the most striking generalization is that contained in the words 'electrolytes are salts,' and his very instructive comparison of the readiness with which a substance enters into double decomposition and the readiness with which it can be electrolyzed. With the fairness to his predecessors which is characteristic of him, he quotes an almost forgotten statement of Gay-Lussac to something like the same effect.

Ladies and Gentlemen,—I wish here to tell you that within the last three weeks Professor Hittorf entered on the fifty-first year of his professorship. The officials of the Royal Institution have authorized me to ask our Chairman, Lord Kelvin, to send your congratulations to Professor Hittorf on his jubilee.

We now come to another turning-point in the development of the theory of electrolysis, inseparably associated with the name of Kohlrausch.* It is to Kohlrausch and to those who worked with him that we owe the methods for the accurate determination of the conductivity of electrolytes. I need not give a description of the apparatus. It is now used in every laboratory, and by means of it a series of observations of the conductivity of an electrolyte can be made at different concentrations in a very short time. An early result of Kohlrausch's investigation was his discovery that 'all acids which have been examined in strong solutions show, for a definite proportion of water, a maximum of conductivity,' and he shows that for many other electrolytes there is a solution which conducts better than one either a little more or a little less concentrated. Thus the maxima of conductivity of the following acids are at the following percentages: HNO_3, 29.7 per cent.; HCl, 18.3 per cent.; H_2SO_4, 30.4 per cent.; $HC_2H_3O_2$, 16.6 per cent. "The maximal acetic acid conducts at least 38,000 times better than concentrated acetic acid." In connection with this he says, 'we do not know one single liquid which at ordinary temperature is, by itself, a good electrolytic conductor.' He refers the trace of conductivity in H_2SO_4 to the dissociation into water and SO_3 observed by Marignac and by Pfaundler, and observes that, as up to the present time we know only mixtures which at ordinary temperature conduct well, the supposition is not unnatural that it is mixture that makes electrolytes good conductors. And again, if what has been said is correct, we must, in order to have good conduction, protect the wandering constituents from frequent meeting with one another, and this service is performed by the solvent, which makes it possible for the ions to get over a part of their journey—and so much larger a part the more solvent there is—without reforming molecules. It is this suggestion which I ventured a little while ago to put into an allegorical form.

In order to compare the conductivity of one electrolyte with that of another, it is necessary that we choose comparable quantities of the two, and there is no difficulty in seeing that such comparable quantities are those decomposed by the same current of electricity—that is to say, the electro-chemical equivalents of the

* Kohlrausch and Nippoldt, *Pogg.*, CXXXVIII., p. 280 (1869); Kohlrausch, *Pogg.*, Jubelband, p. 290 (1874); Kohlrausch and Grotrian, *Pogg.*, CLIV., pp. 1 and 215 (1875); Grotrian, CLVII., p. 130 (1876); Kohlrausch, CLIX., p. 233 (1876). *Göttinger Nachrichten*, 1876, p. 213. *Wied.*, VI., p. 1 (1879); XI., p. 653 (1880).

electrolytes. Accordingly, instead of expressing the concentration in percentage of the solute, Kohlrausch uses 'molecular numbers.' The molecular number of a solution is the quantity, in grams, of the solute contained in a liter of the solution divided by the equivalent of the solute. Dividing the conductivity of a solution by its molecular number gives its molecular conductivity. It will be seen that 'molecular' is not used here in its ordinary chemical sense, but as the meaning is quite distinctly stated no confusion need arise. Kohlrausch showed that the molecular conductivity increases as the solution becomes more dilute, and with extreme dilution approaches a constant value.

I now show an experiment to illustrate this.

The apparatus* consists of an electrolytic cell in the form of a tall rectangular trough, the back and front being broad plates of glass, while the sides are composed of narrow strips of wood completely lined with silver-foil. The bottom of the cell is made of non-conducting material. The two sheets of silver serve as electrodes, being connected to binding screws by means of external wires. The cell is introduced into a battery circuit along with a galvanometer of low resistance. If the cell be filled with pure water there is scarcely an appreciable current transmitted. On removing the water and pouring in 20 c.c. of a 4-normal silver nitrate solution, so as to cover the bottom to a depth of a few millimeters, a current passes as indicated by the galvanometer. If pure water be now added in successive portions and the solution stirred after each addition, an increase in the strength of the current is observed, the increase being greatest after the first dilution, and becoming less with each succeeding dilution, so that a maximum is approached. In this experiment the distance between the electrodes is constant, and the area of the electrodes and of the cross-section of the conducting solution is proportional to the volume of the solution, and the quantity of the salt is constant; therefore any change in the strength of the current means a corresponding change in the molecular conductivity of the dissolved salt. The molecular conductivity, therefore, increases with the dilution, and asymptotically approaches a maximum.

* From a paper by Noyes and Blanchard, in the *Zeitschrift für physikalische Chemie,* XXXVI., p. 9 (1901).

I cannot here enter into a description of the great experimental difficulties connected with the determination of the conductivity of extremely dilute solutions, but I may refer to one of them, namely, the small but variable conductivity of the water used in preparing the solutions. There seems now to be no doubt that water is in itself an electrolyte. But the purest water that has been obtained has a conductivity of only about 10^{-10} as compared with that of mercury as unit. The minutest traces of salts greatly increase the conductivity, so that ordinary distilled water has a conductivity of 3×10^{-10} or more. With solutions of moderate dilution the variation of this very small quantity is of little consequence, but with extremely dilute solutions the conductivity to be measured is of the same order as that of the water.

For our present purpose the most important conclusion drawn by Kohlrausch from his observations is his law of the independent rate of motion of the ions in dilute solutions. The rate of motion of any ion towards the electrode depends on the gradient of potential. But Kohlrausch shows that the rate of motion of each ion in dilute solution is proportional to a number, the same whatever be the other ion of the electrolyte. Thus the rate at which the cation K moves towards the cathode in dilute solution is the same in solutions of KCl, KNO_3, $KC_2H_3O_2$, etc. Kohlrausch gives these numbers for six cations and ten anions. The results calculated from these numbers agree well with the observed conductivities.

Methods have been devised for directly observing and measuring the rate at which ions travel. In this connection I may specially mention the names of Oliver Lodge, Whetham and Masson. These measurements agree very well with the rates calculated by Kohlrausch.

I now show an experiment indicating a way in which such measurements can be made.

The apparatus* consists of a glass U-tube, with a long stopcock-funnel connected to the lower part of it. The tube is nearly half filled with a dilute (about 0.03 per cent.) solution of potassium nitrate, and then about the same quantity of a solution of potassium permanganate, of the same conductivity as the other solution, is slowly introduced by means of the funnel. The permanganate solution is loaded with urea (a non-electrolyte) so as to make it denser than the nitrate solution; the permanganate solution now lies in the lower part of the U-tube with a sharp interface between it and the nitrate solution above it in each limb of the tube. If now we connect the electrodes, which were preliminarily inserted into the upper parts of the limbs of the tube, with a battery with high difference of potential, a current will pass, and a transference of ions will take place, cations (K) towards the cathode and anions (NO_3 and MnO_4) towards the anode, and the column of pink color will rise in the limb containing the anode and fall by an equal amount in the other. By this means an approximation can be made to the rate of travel of the ions.

We now come to a new chapter beginning with 1887; but before entering on it we must turn aside for a little to a subject which does not at first sight seem to have a very close relation with the matter we have in hand. The subject is that of what may be called the osmotic phenomena. These are all connected with the concentration or with the dilution of solutions. They all involve the idea of the work done in concentrating a solution. We need not discuss the theory of these phenomena, we are interested in them now only as they give us methods of ascertaining the molecular concentration of a solution. In 1883* Raoult showed that in the case of a great many substances, equimolecular solutions (with the same solvent) have the same freezing-point In 1886† he showed that equimolecular solutions with the same volatile solvent have the same boiling-point. Molecular is here used in its ordinary chemical sense. These discoveries were eagerly taken up by chemists as promising an important addition to the means at their disposal for determining the molecular weights of substances. Convenient arrangements for applying the methods were devised by Beckmann,‡ and soon came into use in nearly every laboratory. They were almost exclusively used for the determination of the molecular weight of organic substances, and have been found trustworthy in such cases. When, however, van 't Hoff§ in his study of the theory of solutions concluded from theoretical considerations that the depression of the freezing-point and the rise of the boiling-point are proportional to

* Experiment from a paper by Nernst, in the *Zeitschrift für Elektrochemie*, III., p. 308 (1897).

* Raoult, *Compt. rend.*, XCIV., p. 1517; XCV., pp. 187 and 1030 (1882); XCVI., p. 1653; XCVII., p. 941 (1883).

† Raoult, *Compt. rend.*, CIII., p. 1125 (1886); CIV., pp. 976 and 1430; CV., p. 857 (1887). *Zeitschrift f. physik. Chemie*, II., pp. 353 (1888).

‡ Beckmann, *Zeitschrift f. physik. Chemie*, II., pp. 638 and 715 (1888); IV., p. 532 (1889); VIII., p. 223 (1891).

§ van 't Hoff, *Zeitschrift f. physik. Chemie*, I., pp. 500–508 (1887).

osmotic pressure in the case of dilute solutions, the observations made by Raoult and others furnished a number of facts ready for testing the theory. He found that, while in many cases the osmotic pressure calculated from his formula $PV=RT$ agreed, within the limits of experimental error, with the value calculated from the observation, there were a very considerable number where the observed value differed from that given by the formula. He accordingly modified the formula by the introduction of a factor i, so as to make it $PV=iRT$. This factor i is unity in the cases where observation by Raoult's method gives results agreeing with the formula $PV=RT$; in other cases it is greater or less than unity, and indicates the extent of the disagreement. Arrhenius, to whom van't Hoff showed these numbers, pointed out that all the substances which had i greater than unity were electrolytes, and that the deviation had to do with their splitting up into ions. Arrhenius* had before this time (1887) been working at the subject of electrolysis and of the relation between the readiness with which substances undergo electrolysis and the readiness with which they enter into chemical reactions. He had been looking for an explanation of the fact that the conductivity of a solution of an electrolyte is not proportional to its concentration, and had come to the conclusion that this must depend on some of the molecules of the solute being 'active,' that is, taking part in the conduction—while others were inactive, behaving like molecules of a non-electrolyte, and that the proportion of active molecules increases with dilution.

van't Hoff's factor i enabled Arrhenius to give precision to these ideas, and in 1887† he formulated the theory that the 'active' molecules were those which were split into ions. It was now possible to calculate i in two ways and compare the results. Arrhenius gives a list of eighty-four substances, for which there existed at that time data for such calculations, and, calculating the value of i as deduced on his new theory from the conductivity, compares it with the value of i derived from freezing-point observations in each of the eighty-four substances. The agreement does not at first sight strike one as very close, but there are several circumstances which have to be considered in judging them. The whole mass of published observations was taken, the limits of probable error are very different in different cases, and the freezing-point measurements were all made at temperatures a little below 0°, while the conductivity measurements were made at 18°. The comparison was made, not as a demonstration of the theory, but rather as a preliminary trial with such materials as were at hand. The real testing of the theory necessarily came later. So I think we may agree with Arrhenius that, considering all the circumstances, the agreement is not unsatisfactory, except in the case of nine of the substances, and that most of these nine cases are liable to suspicion on other grounds. In 1887, almost at the time when Arrhenius published the paper of which I have just been speaking, Planck* discussed the subjects of the diminution of the vapor pressure and the lowering of the freezing-point in dilute salt solutions from the thermodynamic point of view, and starting from the principle of the increase of entropy, deduced formulæ connecting these quantities with the molecular weight. He says, in conclusion: "This formula claims exact numerical validity. It gives for most substances a greater molecular number than that usually assumed, *i. e.*, a partial or complete chem-

* Arrhenius, *Bihang till kongl. Svenska vetensk. Akad. Handlingar*, 1884, Nos. 13 and 14.

† Arrhenius, *Zeitschrift f. physik. Chemie*, I., p. 631 (1887).

* Planck, *Wied.*, XXXII., p. 495 (1887).

ical decomposition of the substance in the solution. Even if the consequences of this proposition should require an essential modification of the generally prevailing views as to the constitution of solutions, I do not know any fact which shows it to be untenable. Indeed, many observations in other departments (the proportionally strong affinities of dilute solutions, which remind one of the properties of the nascent state, the easy decomposability by the weakest galvanic current, the phenomena of internal friction), are directly in favor of the view that in all dilute solutions a more or less complete decomposition of the molecules of the dissolved substances takes place. Besides, this conception adapts itself well to the opinions developed by L. Meyer, W. Ostwald and S. Arrhenius on the state of the molecules of dissolved substances, as it only goes a step further and fixes numerically the degree of the decomposition."

An objection was taken to Planck's argument. It was said that as his formula contains the ratio of the molecular numbers of the solute and of the solvent, it could not be inferred that that of the solute is greater than its formula leads to, for it might be that the molecular number of the solvent is less than that indicated by its formula. Planck's answer was immediate and obvious. In any expression in which the molecular number of the solvent appears, there also appears as a factor the molecular weight. For instance, in the formula for the depression of the freezing-point the molecular number of the solvent is multiplied by the latent heat of one molecule of the solvent, and similarly in other cases. So that it makes no difference what molecular weight we assume for the solvent, and the use of its molecular number is merely a convenient way of expressing its quantity.

This increase in the number of the molecules, or splitting into ions, was called 'electrolytic dissociation.' It will be seen that it is what Lodge in 1885, in speaking of Clausius's theory, called dissociation. But while it has some obvious resemblances to the dissociation of a gas, there are very striking differences between the cases, and perhaps some of the difficulties in the way of the acceptance of the theory may have arisen from the use of the same word for two things differing so much. We need not, however, discuss the name, but it is well to look for a little at the essentially different nature of the things. This essential distinction consists in the products of the electrolytical dissociation being charged, the one set with positive, the other set with negative, electricity, so that, while in the body of the solution they can move about independently, they cannot be separated by diffusion as the products of the dissociation of a gas can. It is true that the quicker moving ions can, to a small extent, forerun the slower moving ions, and diffuse a little further into pure water or into a more dilute solution, as is shown by the fact that when two solutions of the same electrolyte of different concentration are in contact there is a difference of electric potential between them, but they cannot be separated to any weighable extent in this way. In order to separate from one another two gases uniformly mixed, a certain calculable amount of work has to be done, so that after a gas has been dissociated and wholly or partially converted into a mixture of the two gaseous products, some work has still to be done to get them separately. So it is also in the case of electrolytic dissociation; but while in the former case the decomposition work is the main thing, and the separation work very small, in the latter it is quite the other way. Here the heat of dissociation, that is, the work spent in decomposing the electrolyte into its ions, is small (indeed sometimes negative), while the work to be done to *separate* the ions is always very much greater. Indeed we may quite correctly say that in most highly dissociated solution of hydrochloric acid the hydrogen and the chlorine are still very firmly united, not indeed atom to atom, but each atom of the one kind to all the atoms of the other kind within a certain distance from it. A man does not lose his money when he takes it out of his pocket and puts it into a bank. He does indeed lose his relation to the individual gold and silver coins, and does not know and does not care where these particular pieces of metal are, but he is interested in knowing that they or their like are at his command, and the same sort of work will be required to impoverish him whether his money is in the bank or in his pocket. (I assume, of course, that the bank of our present imagination cannot become insolvent.)

I have said that the test of the theory would come later. It has been going on since 1887, and if time would allow I could give you many cases in which deductions from the theory have been found to agree with close quantitative accuracy with experimental observations. I shall mention only the first, still among the most important, namely, Ostwald's determination of the affinity constants, and his application of Guldberg and Waage's principle to the ions. I could also give you instances in which there have been discrepancies, or apparent discrepancies, and show how in some of these cases the difficulties have been cleared up. The history of this theory has in fact so far been that of every useful theory, for it is in this way only that a theory does its work. I shall select two points for illustration, not because they are more important than others, but because I can illustrate them by means of experiments which do not occupy much time, and can be made visible in a large room. The first has reference to the question, What are the ions in the case of a dibasic acid? As HNO_3 gives as its ions H and NO_3 so we might expect H_2SO_4 to give 2H and SO_4. But we find that until the dilution has advanced to a considerable extent the ions of sulphuric acid are mainly H and HSO_4. This is quite in harmony with the chemical action of H_2SO_4, for, as every chemist knows, at moderate temperatures we have the action $H_2SO_4 + NaCl = HCl + NaHSO_4$, and the temperature has to be raised in order to get the action $NaHSO_4 + NaCl = HCl + Na_2SO_4$. In the first of these experiments we take as the electrolyte a concentrated solution of potassium hydrogen sulphate $KHSO_4$. This gives the ions K and HSO_4. The latter go to the anode and there, on being discharged, form persulphuric acid, or its ions, and potassium persulphate $K_2S_2O_8$, being sparingly soluble, crystallizes out. This is the method by means of which Dr. Marshall discovered the persulphates. The next experiment will illustrate the formation and discharge at the anode of the anion SO_4. We have here dilute sulphuric acid with which is mixed a little manganous sulphate $MnSO_4$. The ion SO_4 when discharged, adds itself to $2MnSO_4$ and forms manganic sulphate $Mn_2(SO_4)_3$, recognized by its red color. This, even in acid solution, is quickly hydrolyzed, giving insoluble manganic hydrate.

The other point I wish to illustrate is the application of Guldberg and Waage's principle to ions. Without entering into any general discussion of this question, I shall merely say that theory leads to the result that the addition of a soluble acetate to a solution of acetic acid diminishes the concentration of H ions, and so makes the solution less effectively acid. This was experimentally proved by Arrhenius in 1890,* by measuring the rate at which cane-sugar

* Arrhenius, *Zeitschrift f. physik. Chemie*, V., p. 1 (1890).

is inverted by acetic acid alone, and with varying quantities of sodium acetate added to it. But as such an experiment cannot be made visible to a large number of spectators at once, I thought of a way of showing the same thing, which, while not capable of the same degree of accuracy, would prove the principle qualitatively. I have here a solution of ferrous acetate to which I have added enough acetic acid to prevent the precipitation of ferrous sulphide on the addition of sulphuretted hydrogen. I add sulphuretted hydrogen; of course no precipitate is formed. I now add a solution of sodium acetate mixed with rather more than three equivalents of acetic acid, so as to make it plain that the effect is not due to the formation of an acid acetate, and you see that we have at once a precipitate of ferrous sulphide. To show that the addition of the water has not produced the result, I add to another portion of the same solution as much water, and you see that no precipitation takes place.

I have not spoken of non-aqueous solutions. At the rise of the dissociation theory, these were generally supposed to be non-conductors, but many of them have now been examined both by scientific workers in the old world, and very specially by our colleagues on the other side of the Atlantic, and have been found to conduct electrolytically. It seems likely that these investigations will throw much light on the influence of the solvent on the conductivity of the dissolved salt. Particularly interesting is the relation, indicated in some cases, between the specific inductive capacity of a solvent and the dissociation of the dissolved salt. But this is one of the questions not yet ripe for treatment in a discourse such as this.

I had also thought of saying something as to the atomic character of electricity, and the compounds of electricity with what we may venture to call the other chemical elements, and had even some idea of poaching on Lord Kelvin's domain of 'Aepinus atomized,' but time has saved me from this.

I have been describing the history of the theory of electrolysis from the time of Faraday, in such a way as is possible within the limits of an hour. I have necessarily omitted mention of many active, able and successful workers, and I cannot in every case justify the omission except by referring to the time limit. I have as far as I could explained the evidence which we have for the theories described, but I have not intended to argue for or against the essential truth of them. I have sometimes been asked in reference to the theory of electrolytic dissociation, Do you really believe it to be true? My answer to that question is, I believe it to be an eminently useful theory. It has led to a great deal of most valuable experimental work. It has enabled us to group together things that without its help seemed very little connected. It has led to the discussion of problems that could scarcely, without its suggestion, have occurred to any one. It does not seem to be exhausted, and I look forward to much good to be got from it yet, and therefore I am willing to take it as a guide. But I do not look on it as an infallible guide; we cannot expect, we do not need, an infallible guide in physical science. A long life may be anticipated for this theory; if that be so, we may be sure that it will undergo modifications, for if it is to act, it will be acted on.

Nothing but good can come from the fullest discussion, either of the theoretical basis or of the experimental evidence for or against a theory. No great principle in science or in law can be satisfactorily settled without full argument by competent advocates on both sides, and the eager hunt for evidence by those who attack and by those who defend will lead to a more complete investigation of the whole field than would be attained without such—shall we call it partisan?—interest.

A. CRUM BROWN.

THE BOTANICAL SOCIETY OF WASHINGTON.

BOTANICAL development at the national capital has been so rapid within the last few years that few outside of Washington comprehend that it has become the leading botanical center of America and is rapidly taking position as one of the leading botanical centers of the world. Probably no city in the world can boast of a larger number of well-trained professional men devoting their entire time to the study of botany in some one of its various branches. The aggregation of so large a number of professional botanists has finally led to the formation of a general botanical society which is of more than passing interest, as there is hardly a university of any note in the country that is not represented by graduates among its members.

The Biological Society of Washington was the first society organized in Washington which gave any attention to botanical matters. This society was too formal and did not allow of sufficient discussion to suit some of the botanists, and as a result in 1893 the 'Botanical Seminar' was organized, the original membership including Messrs. F. V. Coville, D. G. Fairchild, B. T. Galloway, Theo. Holm, E. F. Smith and M. B. Waite. The main aim of the Seminar was to discuss general problems of plant physiology and pathology and to promote a friendly spirit of criticism. In the early days of the Seminar no member published a paper until it had been read or summarized before the Society and had run the gauntlet of criticism which, the writer can testify, was frequently so severe as to be perilous to the peace of mind of the member under criticism. In no other society which the writer has ever attended was criticism so freely indulged in, or, it may be remarked, so pleasantly received. As it is axiomatic that no two minds ever think exactly alike, so it came to be an understood thing that no paper would suit everyone and many a lively discussion and tilt of warm words resulted.

The organization of the Seminar was somewhat novel, being mainly remarkable for its lack of organization. The Seminar had no officers and no constitution and its membership, though very exclusive, existed only as tradition or in memory. The meetings were held at the residences of members, the host of the preceding meeting acting as chairman. The membership was limited to twenty-five and unanimous consent of all members was required for election to membership.

In the nine years of its existence the Seminar filled an important place in Washington's botanical development, both scientifically and socially. A light lunch was served at each meeting and these light lunches, which sometimes became heavy, served as they were at 11 P.M., became famous among the members. It may be said that the fire of scientific enthusiasm requires no midnight lunch to feed upon, but it is certain that no matter how keenly the scientific fire burns a lunch during the evening adds to the flow of ideas and is conducive to 'that satisfied feeling' which makes all members regular attendants.

Within a few years the number of botanists in Washington became too large to be accommodated in the botanical seminar, meeting as it did in private houses, and in 1898 the Washington Botanical Club was organized particularly to consider the problems of systematic botany and furnish a means of communication between botanists interested in systematic and ecological studies. The organization of this club was largely brought about through the activity of Mr. C. L. Pollard and the late Gilbert H. Hicks. The general plan of this organization was similar to that of the seminar, but differed in having a corps of regular officers.

Dr. E. L. Greene was elected as the first president and Mr. C. L. Pollard as the first secretary, and they were retained in these offices until the society disbanded, when the Washington Botanical Society was organized.

The Botanical Seminar and Botanical Club worked harmoniously and well for a few years, but the rapidly increasing number of botanists in Washington rendered it desirable that a general society should be organized in which all of the botanists could be brought together at least occasionally. Private houses were in general found to be too small to accommodate comfortably even a membership of twenty-five, to which the seminar was limited, and numerous botanists of equal professional rank were asking for admission.

The organization of the Botanical Society of Washington was finally effected by a resolution of the constituent societies at a joint meeting held November 28, 1901. The course of events leading up to this action was as follows:

As a result of the general sentiment in favor of consolidation the Botanical Seminar appointed a committee consisting of Messrs. H. J. Webber, O. F. Cook and M. B. Waite, and the Botanical Club a committee consisting of Messrs. C. L. Pollard, David White and William R. Maxon, to consider plans of organization. As a result of the deliberation of the committee a plan of organization was devised and a joint meeting of the two societies was called at which the organization was perfected and the following constitution was adopted:

CONSTITUTION.

Article I.

The name of this Society shall be the Botanical Society of Washington.

Article II.

The object of this Society shall be the exposition and discussion of the results of botanical investigations, and the promotion of social intercourse among the members.

Article III.

The members of the Society shall be residents of Washington or vicinity having a professional interest in botanical science.

Article IV.

1. The officers of the Society shall consist of a President, a Vice-President, a Recording Secretary, a Corresponding Secretary and a Treasurer. These officers shall constitute the Executive Committee.

2. Officers shall be elected annually by ballot, and shall hold office until their successors are elected. The Executive Committee shall have power to fill vacancies until the next annual election.

Article V.

This Constitution may be amended at any regular meeting by a two thirds' vote of the total membership, written notice of the proposed amendment having been submitted at the preceding regular meeting. Absent members may register their votes by letter.

The first officers of the society, elected at the same meeting, were as follows: President, Albert F. Woods; Vice-President, F. V. Coville; Recording Secretary, C. L. Pollard; Corresponding Secretary, Herbert J. Webber; Treasurer, Walter H. Evans.

One novel feature of the society is that while the president presides at all business meetings and represents the Society officially as in ordinary societies, spice is given to the scientific programs by the by-law which provides that 'the scientific program of each regular meeting shall be conducted by a Chairman of Program; and that the same Chairman shall not preside over more than one meeting during the year.'

Meetings are held monthly and each meeting is preceded by an informal dinner at the regular dinner hour, 5:30 P.M. The following is a list of the present members of the Society:

LIST OF MEMBERS.

Carleton R. Ball, M.S. (Iowa Agricultural College). Assistant Agrostologist, Department of Agriculture.

William R. Beattie, B.S. (Ohio State University). Assistant in Testing Gardens, Department of Agriculture.

Ernst A. Bessey, M.A. (University of Nebraska). Assistant in Charge of Seed and Plant Introduction, Department of Agriculture.

Edgar Brown, Ph.B. (Union College). Assistant Botanist, Department of Agriculture.

Frank K. Cameron, A.B., Ph.D. (Johns Hopkins University). Soil Chemist, Department of Agriculture.

Mark A. Carleton, M.S. (Kansas Agricultural College). Cerealist, Department of Agriculture.

Joseph S. Chamberlain, M.S. (Iowa Agricultural College), Ph.D. (Johns Hopkins University). Expert in Physiological Chemistry, Department of Agriculture.

Victor K. Chesnut, B.S. (University of California). Botanist in Charge of Investigations of Poisonous Plants, Department of Agriculture.

Guy N. Collins, Assistant Botanist in Tropical Agriculture, Department of Agriculture.

O. F. Cook, Ph.B. (Syracuse University). Botanist in Charge of Tropical Agriculture, Department of Agriculture.

Lee C. Corbett, M.S. (Cornell University). Horticulturist of Bureau of Plant Industry, Department of Agriculture.

Frederick V. Coville, A.B. (Cornell University). Chief Botanist, Department of Agriculture.

Lester H. Dewey, B.S. (Michigan Agricultural College). Assistant Botanist in Charge of Investigations of Fiber Plants, Department of Agriculture.

Benjamin M. Duggar, A.M. (Harvard University), Ph.D. (Cornell University). Plant Physiologist, Department of Agriculture.

Arthur W. Edson, B.S. (University of Vermont). Scientific Aid in Plant Breeding Laboratory, Department of Agriculture.

Walter H. Evans, M.S., Ph.D. (Wabash College). Botanical Editor *Experiment Station Record*, Department of Agriculture.

David G. Fairchild, B.S. (Kansas Agricultural College). Agricultural Explorer, Department of Agriculture.

Beverly T. Galloway, B.S. (University of Missouri). Chief of the Bureau of Plant Industry, Department of Agriculture.

Harris P. Gould, B.S. (University of Maine), M.S. (Cornell University). Assistant Pomologist, Department of Agriculture.

Edward L. Greene, Ph.B. (Albion College), LL.D. (University of Notre Dame). Professor of Botany, Catholic University of America.

David Griffiths, M.S. (South Dakota Agricultural College), Ph.D. (Columbia University). Assistant Agrostologist in Charge of Range Investigations, Department of Agriculture.

Charles P. Hartley, M.S. (Kansas Agricultural College). Assistant in Plant Breeding Laboratory, Department of Agriculture.

Albert S. Hitchcock, M.A. (Iowa Agricultural College). Assistant Agrostologist in Charge of Cooperative Experiments, Department of Agriculture.

Fred. H. Hillman M.S. (Michigan Agricultural College). Assistant in Seed Herbarium, Botanical Investigations, Department of Agriculture.

Thomas H. Kearney, Assistant Physiologist in Plant Breeding Laboratory, Department of Agriculture.

Karl Kellerman, B.S. (Cornell University). Scientific Aid, Plant Physiological Laboratory, Department of Agriculture.

Frank H. Knowlton, M.S. (Middlebury College), Ph.D. (Columbian University). Paleontologist, Geological Survey.

William R. Maxon, Ph.B. (Syracuse University). Aid in Cryptogamic Botany, Division of Plants, National Museum.

R. E. B. McKenney, M.S. (University of Pennsylvania), Ph.D. (Basel University). Expert, Vegetable Physiological and Pathological Investigations, Department of Agriculture.

George T. Moore, M.A., Ph.D. (Harvard). Algologist and Plant Physiologist, Department of Agriculture.

Edward L. Morris, A.M. (Amherst College). Head of the Department of Biology, Washington High Schools.

Jesse B. Norton, M.S. (Kansas Agricultural College). Scientific Aid in Plant Breeding Laboratory, Department of Agriculture.

J. B. S. Norton, M.S. (Kansas Agricultural College). Professor of Botany and State Pathologist, Maryland Agricultural College and Experiment Station.

William A. Orton, M.S. (University of Vermont). Assistant Plant Pathologist, Department of Agriculture.

Adrian J. Pieters, B.S. (University of Michigan). Botanist in Charge of Seed Laboratory, Department of Agriculture.

Charles L. Pollard, A.B., A.M. (Columbia University). Assistant Curator, Division of Plants, National Museum.

G. Harold Powell, M.S. (Cornell University). Assistant Pomologist, Department of Agriculture.

Percy L. Ricker, M.S. (University of Maine). Scientific Aid in Agrostology, Department of Agriculture.

J. N. Rose, M.A., Ph.D. (Wabash College). Assistant Curator, Division of Plants, National Museum.

Filibert Roth, B.S. (University of Michigan). Chief of Forestry Division, in Charge of U. S. Forestry Reserves, Department of Interior.

Carl S. Scofield, B.S. (University of Minnesota). Expert on Cereals, Department of Agriculture.

Cornelius L. Shear, A.M. (University of Nebraska). Assistant Plant Pathologist, Department of Agriculture.

Erwin F. Smith, B.S., D.Sc. (University of Michigan). Pathologist in Charge of Laboratory of Plant Pathology, Department of Agriculture.

William J. Spillman, M.S. (University of Missouri). Chief Agrostologist, Department of Agriculture.

Dean B. Swingle, B.S. (Kansas Agricultural College), M.S. (University of Wisconsin). Scientific Aid in Laboratory of Plant Pathology, Department of Agriculture.

Walter T. Swingle, M.S. (Kansas Agricultural College). Physiologist in Charge of the Laboratory of Plant Physiology, Department of Agriculture.

William A. Taylor, B.S. (Michigan Agricultural College). Pomologist in Charge of Field Investigations, Department of Agriculture.

Charles O. Townsend, M.S. (University of Michigan), Ph.D. (Leipzig). Plant Pathologist, Department of Agriculture.

J. E. W. Tracy, B.S. (Michigan Agricultural College). Expert Seed Tester, Department of Agriculture.

Rodney H. True, M.S. (University of Wisconsin), Ph.D. (Leipzig). Plant Physiologist, Department of Agriculture.

Merton B. Waite, B.S. (University of Illinois). Pathologist in Charge of Investigations of Diseases of Orchard Fruits, Department of Agriculture.

Herbert J. Webber, M.A. (University of Nebraska), Ph.D. (Washington University). Plant Physiologist in Charge of Laboratory of Plant Breeding, Department of Agriculture.

David White, B.S. (Cornell University). Geologist, Geological Survey.

Milton Whitney, Chief of the Bureau of Soils, Department of Agriculture.

William F. Wight, B.S. (Michigan Agricultural College), M.A. (Stanford University). Assistant, Geographic Botany, Department of Agriculture.

Earley V. Wilcox, Ph.D. (Harvard University). Associate Editor of *Experiment Station Record*, Department of Agriculture.

Albert F. Woods, M.A. (University of Nebraska). Chief Pathologist and Physiologist, Department of Agriculture.

Total membership, 57.

The plan of organization of the Society provides that, whenever it seems desirable, seminars may be formed for the study and discussion of special topics. Such seminars are to be associated with the Society and to be conducted mainly on the plan of the original Botanical Seminar. Four such seminars have already been formed, namely: (1) Agronomic Seminar, (2) Physiological and Pathological Seminar, (3) Plant Breeding Seminar, (4) Systematic Botanical Seminar.

Botanical activity in Washington is rapidly increasing and the present list of members will probably be greatly enlarged within the next year.

It is not probable that the Society will publish proceedings or issue any papers in the near future; but hereafter reports of the meetings will be furnished to Science whenever the program is of such a nature as to justify a report.

Herbert J. Webber,
Corresponding Secretary.

THE MOSQUITO CAMPAIGN IN NEW JERSEY.

There has been much comment in the Press on the above matter since Assembly bill No. 31 was first introduced in the New Jersey Legislature. Though the bill is very short, few journals printed it, and when printed it appears that very few read it carefully enough to understand its real purport. The common belief seems to be that for the sum of $10,000 the State Entomologist is to destroy all the mosquitoes in the state during the current season. It needs only the most casual acquaintance with the character of the problem to make it obvious that any attempt to such an end would be foredoomed to ridiculous failure; but it was just this misapprehension that is accountable for such opposition as the real scheme met with. The act is so short and its objects are so briefly set out that it is here presented in full.

AN ACT TO PROVIDE FOR AN INVESTIGATION AND REPORT BY THE NEW JERSEY AGRICULTURAL EXPERIMENT STATION, UPON THE MOSQUITO PROBLEM, IN ITS RELATION TO THE SANITARY, AGRICULTURAL AND OTHER INTERESTS OF THE STATE.

Be it enacted by the Senate and General Assembly of the State of New Jersey:

1. That the New Jersey Agricultural Experiment Station be and the same is hereby empowered and directed to investigate and report upon the mosquitoes occurring within the State, their habits, life history, breeding places, relation to malarial and other diseases, the injury caused by them to the agricultural, sanitary and other interests of the State, their natural enemies, and the best methods of lessening, controlling or otherwise diminishing the numbers, injury or detrimental effect upon the agricultural, sanitary and other interests of the State.

2. The sum of ten thousand dollars is hereby appropriated to the New Jersey Agricultural Experiment Station to be applied to and expended for the purposes mentioned in section one of this Act. Such expenditures to be made and accounted for in the same manner as are the other moneys appropriated to said Station.

3. This Act shall take effect immediately.

This act passed the House with little opposition and by a good majority; but in the Senate it encountered active hostility. That body could not be persuaded that there was a serious purpose behind the bill. Nevertheless it was favorably reported from the committee to which it had been referred, only to find a place in the presiding officer's 'forgotten corner,' whence, it was intended, it should never be removed. But even Senators change sometimes and, for some reason, the bill was resurrected, brought up for final reading and lost by a tie, changed to a negative vote by one of the advocates of the measure who voted nay that he might move for a reconsideration. The motion to reconsider was made and tabled, leaving a chance for life which was seized in the closing hours of the session.

Public opinion expressed by the newspapers had been and continued to be almost uniformly favorable to the measure and this induced some of the opposition to change their previous negative to affirmative votes.

Nominally therefore the Legislature of the State of New Jersey had passed a bill appropriating $10,000 for an investigation and report on the mosquito question and this act was approved by the Governor in due time.

A general State law requires that all sums of money to be paid out by the Comptroller must be included in one of the regular appropriation bills. The regular appropriation bills, however, have been completed and were upon final passage when the mosquito bill passed. No mention of any sum of money for this purpose appears in either the supplementary or the regular appropriation bill passed by the Legislature, consequently there was no money available for the purposes of the act, which, so far as the law-making body is concerned, would have to remain inoperative until a future session should see fit to provide the necessary funds.

The matter was presented to the Governor of the State and he was asked to consider a request to devote a small sum from an emergency fund, which is under his personal control, that an organization for work might be effected. The Governor had already expressed a favorable interest in the subject and after consideration agreed to assign the sum of one thousand dollars to the purposes mentioned in the bill. It is quite obvious that this sum is totally inadequate to the carrying out of the plan originally formulated, which involved the expenditure of ten times the amount in hand; but considerable preliminary work may be done that will simplify matters when the full sum becomes finally available.

One part of the fund will be devoted to an investigation of the conditions which favor the transmission of malaria in certain districts in the State, and a competent man has been secured for that purpose. He will be located in a malarial district where *Anopheles* is abundant and its breeding places numerous. This will afford opportunity for a careful study of the condition under which these mosquitoes are able to carry the organisms causing the disease. The student will be supplied with material from other districts in the State where malaria as an endemic disease is practically unknown. This material will be used in comparison with that collected in the infected locality, and if possible a comparative study of the media in which the larvæ breed will be made.

Another subject that will be taken up by one thoroughly qualified for the work is a study of the food habits of such vertebrates as live in the waters inhabited by mosquito larvæ. It is further expected that collections will be arranged for throughout the State that the mosquito fauna may be thoroughly understood, and the various species locally involved may be intelligently considered.

The general survey of the salt-marsh region, which was contemplated as part of the original plan, will have to be postponed for the present. It will be possible, however, for me to cover the ground in a preliminary way, that I may be fully informed when I am able to put field parties into active service.

Aside from the general work here outlined some of the more common species will be bred in the laboratory in quantities sufficient to allow of experiments with poisonous materials. The application of oil on a large scale has been found somewhat unsatisfactory, and while there is no doubt of its effectiveness in general, there are occasions when its use should be avoided if possible.

This outline of what has been done and what it is expected to do is presented that the scientific world at least should be under no misapprehensions in this matter.

John B. Smith.

New Brunswick,
May 15, 1902.

SCIENTIFIC BOOKS.

A University Text-book of Botany. By Douglas Houghton Campbell, Ph.D., Professor of Botany in the Leland Stanford Junior University. New York, The Macmillan Company; London, Macmillan & Co., Ltd. 1902. All rights reserved. 8vo. Pp. xv + 579. With many illustrations.

It has been the pleasant task of the present reviewer on several previous occasions to notice books prepared by Dr. Campbell, each time with increased interest. There was first a little text-book for High Schools—the 'Elements of Structural and Systematic Botany'—which appeared twelve years ago, and justified the reviewer's favorable estimate. Five years later came that admirable book—the 'Structure and Development of Mosses and Ferns'—which has been a handbook of advanced botanists since its publication. This was followed in 1899 by 'Lectures on the Evolution of Plants,' one of the most suggestive and readable of recent books on the philosophical aspects of botanical science. We may see the steps in the evolution of a leading botanist in the preceding books, especially when we add to the list the one which has just appeared, and which is here to be noticed.

The author brings to the task of preparing a book for university students long experience in teaching in the high school, as well as the university, and his many explorations in new fields of botanical research add greatly to his preparation. One might say that his earlier works have been preparatory to this, and that in their preparation he was laying the foundations upon which to build this compendium of the science. He has made this a book of reference, and it is very distinctly stated that it is not a laboratory manual. We have here an indication of a recession of the tide which at one time seemed likely to sweep away everything that was not of and for the laboratory or the field. The book is thus a contribution to the discussion of the methods of teaching botany, and as such we welcome it as an omen of better things than we have had. It is an 'all-round' book, and the student who is so fortunate as to be led through it by a competent teacher will not come out of the university with one-sided notions of the subject. It should represent the 'general botany' course in the university, as distinguished from the botanical work in the college. Upon what is contained in it the student who intends to become a professional botanist or who wishes to take up particular lines of work in restricted fields may build with safety.

The book is made up of fifteen chapters, as follows: I., 'Introduction' (in which certain generalities are discussed); II., 'The Plant-body' (which is general morphology); III., 'The Plant-cell'(cytology and histology); IV., 'Classification' (really devoted to the Flagellata, Myxomycetes, Schizomycetes, Schizophyceæ and Diatoms); V., 'The Algæ'; VI., 'Fungi'; VII., 'The Archegoniatæ (Bryophyta)'; VIII. and IX., 'Pteridophyta'; X., 'Spermatophyta (Gymnosperms)'; XI., 'Angiospermæ (Monocotyledones)'; XII., 'Dicotyledones'; XIII., 'Physiology'; XIV., 'Relation to Environment'; XV., 'Geological and Geographical Distribution.' There is thus a fair balance in the treatment of the different parts of the subject.

In looking over these chapters we are particularly pleased with those on the 'Plant-cell' (III.), the 'Bryophyta' (VII.), and the 'Pteridophyta' (VIII. and IX.). Here the author is quite at home, and the treatment is with a firmer hand than elsewhere. These chapters afford him the opportunity of applying his intimate knowledge of these groups in the presentation of the matter in pedagogical as well as scientific form. It is needless to say that the whole presentation is from the standpoint of modern evolution, and at every step the student is led to see that all forms are derived from similar antecedent forms. Yet the author is cautious, and does not assume to know all of the details of the evolution of present vegetation. It is a sound, scientific book, a credit to American botanical science.

CHARLES E. BESSEY.
THE UNIVERSITY OF NEBRASKA.

Text-book of Zoology Treated from a Biological Standpoint. By DR. OTTO SCHMEIL. Translated from the German by RUDOLPH ROSENSTOCK. Edited by J. T. CUNNINGHAM. London, A. and C. Black. 1901. Pp. xvi+493.

The first impression that this book is apt to make upon the morphologically trained zoologist is that it is somewhat crude and often deals with merely trivial matters. A more careful study of the book shows that the first impression is an inadequate one. Here we have a philosophical treatise of zoology: one of the first. Thus even the morphological reader will admit now that it is becoming clear that morphology demands a physiological interpretation. And that is what the author of this book attempts to give us. As an example of the method let us take the treatment of the European wild boar (*Sus scrofa*). First, a brief statement as to dimensions and weight (how important for structure!). Next, "The wild boar prefers for its habitat swampy forest thickets, which are avoided by all other native mammals. Hence it is hardly surprising that in the structure of its body this animal exhibits marked differences from all the other habitants of the forest." Like the elephant, it forces its way through the thickets. It is consequently equipped with (1) a conical head; (2) short, powerful legs; (3) tough skin; (4) coat of bristles; (5) deep-set eyes. It lives in the marsh. The separating toes prevent sinking; the body is kept from cooling in the water by the thick layer of fat. The bristles dry quickly so that little heat is lost. The boar is omnivorous, hence such and such teeth, hearing, sight. It burrows, hence shape of head, snout, canine teeth, muscles of neck, spinous processes of cervical vertebræ, distribution. Finally the boar has certain relations to man.

This method is followed throughout the book. It is very illuminating. The great difficulty is that in the attempt to explain everything one cannot but feel that the author sometimes resorts to explanations that are merely possible and plausible.

On the whole, however, the book is to be strongly commended to the general reader and to the consideration of the teacher of zoology in secondary schools and colleges. This is the sort of zoology that is to be preferred to pure morphology as an introduction to the science. The selection of such heavy paper and large size of pages seems unfortunate for a text-book, for, because adding to the price of the book, they must restrict its use.

C. B. Davenport.

Handbook on Sanitation. A Manual of Theoretical and Practical Sanitation. By George M. Price, M.D. New York, John Wiley & Sons; London, Chapman & Hall, Ltd. 1901. 12mo. Pp. xii + 317; figs. 31. Cloth, $1.50 *net.*

The book is of four parts, 'Sanitary Science,' 'Sanitary Practice,' 'Sanitary Inspection' and 'Sanitary Law.'

Part one is stated to be a 'condensed but comprehensive résumé of the best text-books.' It is vastly too condensed to be of use to 'students and physicians.' Thus the question of 'water and water-supply' is disposed of in seven and a half pages, and nine and a half are given to 'sewage and sewage disposal.'

Carbon dioxide should not be classed as a 'virulent poison,' and the statement that carbon monoxide 'may produce death when inhaled in large amounts' does not do justice to the highly poisonous qualities of that gas.

On page 21 it is written that 'as a rule the height of a room ought to be about one third of the cubic space.'

The error of such an expression is apparent. Possibly the author had in mind the 'cube root' rather than 'one third.'

The chapters on plumbing are good and well illustrated.

Considerable information of value, such as tables of measurements, elementary mensuration, extracts from civil service rules, and tenement-house law, is included in the last half of the volume. As a whole, the book contains material useful to a certain class of inspectors, but it is an error to entitle it 'a manual of theoretical and practical sanitation.'

SCIENTIFIC JOURNALS AND ARTICLES.

The Botanical Gazette for May contains the following articles: The third and last part of the paper by Frederick C. Newcombe on 'The Rheotropism of Roots' appears, and the paper as a whole embodies important results from several years of experimentation. Mr. Newcombe's first paper upon the subject was read before the American Association in 1896. The detailed results of the numerous well-devised experiments cannot be given, but the conclusion of the whole matter may be summed up as follows: Rheotropism is an obscure phenomenon manifested in the curving of roots against a stream of water. The author finds the response not general among plants, there being but twenty sensitive species out of thirty-four tested. Velocities of flow causing a response may range from 0.1 cm. to 500 cm. per minute, though the strongest curves are formed in velocities between 100 cm. and 500 cm. per minute. A remarkable discovery was made in finding the roots sensitive not only at the apex and throughout the elongating zone, but for some distance beyond the elongating zone. Rheotropism is not a transitory phenomenon, but persists in the maturing plant. It is perhaps a response to pressure, though terrestrial roots are not known to be sensitive to pressure. Kiichi Miyake writes 'On the Starch in Evergreen Leaves and its Relation to Photosynthesis during the Winter.' The work was carried on at the Tokyo Imperial University and the conclusions reached have to do with conditions in Japan. The starch in evergreen leaves in general begins to decrease in November, reaching its minimum during January, and increasing again from the end of February. During the winter many evergreen leaves contain starch, and this starch, as experiments showed, is formed by photosynthesis in winter and its translocation occurs in the same season. This phenomenon is true of middle and southern Japan, but in northern Japan most evergreen leaves lose their starch in winter. The opening of the stomata in winter was also observed in some evergreen leaves in Tokyo. James B. Overton describes 'Parthenogenesis in *Thalictrum purpurascens.*' Embryos were produced parthenogenetically under all artifical conditions, and wild material showed the phenomenon to be general in nature. The cytoplasm of the early stages of the sac is closely packed about the egg, which later becomes surrounded by a modified zone which may affect the osmotic pressure and indicate a withdrawal of water, causing the egg to divide. No differences could be detected in the development and vigor of normal and parthenogenetic embryos, except that the latter is slower in starting. *Thalictrum* is the third genus of angiosperms in which parthenogenesis has been recorded, the others being *Antennaria,* described by Juel, and *Alchemilla,* described by Murbeck. R. G. Leavitt describes some subterranean plants of *Epiphegus,* which were dwarf specimens, buried one or two inches deep, but with flowers and fruit in all stages of development. D. G. Fairchild, in continuing his 'Notes of Travel,' describes the bright-colored autumn foliage of American trees in Europe, special mention being made of *Quercus rubra* and *Acer dasycarpum.* T. D. A. Cockerell describes a new *Heliotropium* from New Mexico.

THE May number of *Popular Astronomy* has two brief articles by J. E. Gore, of England; the one on 'Immensity and Minuteness' brings out the vastness of the numbers dealt with in astronomy, and contrasts them with the minuteness of atoms as revealed by the microscope. He cites as illustrations that the distance of the nearest fixed star is 271,000 times the distance of the sun, and the fact that certain forms of infusoria are so minute that an individual specimen can lie between two divisions of an inch divided into 25,000 parts. Mr. Gore's second article gives his new method of computing the value of starlight in terms of moonlight. William L. Hornsby, for some years a resident of China, writes from Macao of 'The Chinese Calendar.' He finds that calendars in China date back to their earliest classic records, and traces the history of their calendars to modern times including extracts from those of the present day, which show a curious mixture of astrology, superstition and astronomy. Other popular articles are 'Shadows Cast by Starlight,' by Henry Morris Russell, and an account of the appearance of the 'The Stellar Floor' as seen through the clear steady atmosphere at Mt. Lorne Observatory, by Edgar L. Larkin; also a review of the Solar Observations of 1900, and a brief account by Dr. T. D. Anderson, the discoverer of Nova Persei, of his 'Searching for New Stars.'

SOCIETIES AND ACADEMIES.

SIXTH REGULAR MEETING OF THE BOTANICAL SOCIETY OF WASHINGTON.

THE sixth regular meeting of the Botanical Society of Washington was held at the Portner Hotel, March 29, 1902, with President A. F. Woods in the chair. At the conclusion of the business meeting, Mr. A. J. Pieters, chairman of the program for the evening, was called on to preside.

Professor A. S. Hitchcock discussed a peculiar specimen of short-leaf pine which he had observed. The tree had been girdled and had continued growing above the wound, so that while the circumference below the girdled area was about 24¼ inches, the tree above had expanded to a circumference of about 47 inches. The discussion developed the fact that this occurrence is not unusual in some kinds of trees when they have been girdled.

The main portion of the evening was devoted to a symposium on Cuban vegetation.

Mr. C. L. Pollard briefly suggested the ecological areas as he recognized them, illustrating his remarks by mounted specimens.

Mr. William Palmer, of the U. S. National Museum, gave an exhaustive account of the geological formations of the island and their effect on vegetation. Mr. Palmer also discussed at some length the influence annual fires have had on the vegetation.

By invitation, Dr. C. F. Millspaugh, of the Field Columbian Museum, gave a short address on West Indian vegetation in general, pointing out the life zones and commenting on the zones of vegetation. A brief discussion followed on the character of the peculiar red soils common in most parts of Cuba. Mr. Woods pointed out that these soils are also common in Bermuda and that it is probable that in many cases such soils are subject to change of color after long cropping.

Herbert J. Webber,
Corresponding Secretary.

SEVENTH REGULAR MEETING OF THE BOTANICAL SOCIETY OF WASHINGTON.

The seventh regular meeting of the Botanical Society of Washington was held at the Portner Hotel, April 26, 1902, with President A. F. Woods in the chair.

Mr. L. C. Corbett called attention to the use of ether in forcing dormant plants into flower. Experiments which have been conducted indicate that treatment with fumes of ether in tight receptacles covering the tops will succeed in bringing dormant plants into bloom in from twelve to fourteen days. Experiments thus far conducted have been mainly with the lilac.

Mr. A. F. Woods called attention to the fact that the treatment of seeds with ether hastens germination, and spoke briefly of experiments conducted by himself which demonstrated this fact.

Mr. V. K. Chesnut reviewed a paper by Dr. Maurice Henseval entitled 'L'Abrine du Jéquirity,' published in *La Cellule,* Vol. 17, pp. 139–197, 1900. In this paper the author describes numerous accurately performed experiments upon the smaller animals with sterilized solutions containing a definite quantity of the toxalbumin *abrin,* extracted from the seeds of *Abrus precatorius,* showing in considerable detail its chemical, physical and physiological characteristics, especially in their relation to the destruction of abrin in the intestines and by leucocytes.

Dr. C. O. Townsend discussed a report by Professor Jones, of the Vermont Experiment Station, on the 'Use of Bodo and Pyrox,' two fungicides prepared by the Bowker Chemical Company. Bodo, it was stated, compares in general with Bordeaux mixture, while pyrox compares with a mixture of Bordeaux and Paris green, and is used as a fungicide and insecticide. In Professor Jones' experiments it was found that these preparations gave very satisfactory results. Dr. Townsend also mentioned experiments made by himself with bodo in which very satisfactory results were obtained. The conclusion seemed to be that while bodo may not be as effective as freshly prepared Bordeaux mixture, when properly made, it is probably better than improperly prepared Bordeaux.

Mr. M. A. Carleton called attention to two general laws regarding seed of wheats which have come to be generally understood. (1) That in case of spring wheats seed brought from the north ordinarily ripens earlier and gives better yields and quality than seed of the same variety brought from the South. (2) That in the case of winter wheats just the opposite is true, that is, that seed from the South gives the best results. This was stated as being a general law for winter crops. As a rule seed from the South in the case of winter crops ripens earlier and yields better than seed from the North. Mr. C. R. Ball called attention to the fact that varieties of cow-peas which in the South produce running vines when transplanted to the North change to a bushy habit.

Mr. C. P. Hartley outlined some results obtained in growing corn from red-eared sports. In one case a pure red ear was found in a field of a white race which had been bred true to type for a number of years. Seed from this red ear was planted, and in the first generation about 45 per cent. of the progeny had red ears while the remaining 55 per cent. gave white ears. Some of the red ears were self-fertilized, and in the second generation grown from such self-fertilized seed 83 per cent. of red ears were produced. Another sport was described where in a race of pure bred white corn an ear was produced which was mainly red, but had a white spot at the base on which the kernels were white with very fine red stripes. The red grains from this ear when planted produced progeny in which 50 per cent. of the ears were red, while the kernels from the white spot gave progeny in which 50 per cent. of the ears had seed like that planted, with fine red stripes, and 50 per cent. had pure white ears.

Mr. H. J. Webber exhibited a plant of trailing arbutus (*Epigœa repens*), received from South Carolina, which produced double flowers. The doubling was caused by the stamens developing into petals, the expanded filaments being united into a tube similar to the corolla in which it was inserted. Mr. Webber also called attention to an experiment with cotton, showing the prepotency of pollen of different species. In the summer of 1900 flowers of Sea Island cotton were opened about 7 A.M. and abundantly pollenated with their own pollen, after which they were bagged. These same flowers were opened again about 11 A.M.—four hours later—and dusted abundantly with pollen of upland cotton. The seeds produced by such cross-pollenated flowers were planted the next year and gave over 50 per cent. of true hybrids, showing that pollen of upland cotton on Sea Island is sufficiently prepotent over the plant's own pollen to give a large percentage of hybrids even when applied four hours later. It was pointed out that results similar to these were obtained by Darwin in experiments with different varieties of cabbage.

HERBERT J. WEBBER,
Corresponding Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

AT the 131st meeting, held May 14, 1902, the following papers were presented by members of the Maryland Geological Survey: 'The Potomac Group in Maryland,' by W. B. Clark and A. Bibbins.

The Potomac group is composed of four distinct formations called from below upward the Patuxent, the Arundel, the Patapsco and the Raritan formations. These are separated by clearly defined unconformities. The two lower formations are provisionally assigned to the Jurassic because of the discovery by Professor Marsh of dinosaurian remains within the Arundel formation, the dicotyledonous plant remains being mainly confined to the Patapsco and Raritan formations. Only a few dicotyledons are known from the lower formations. By the gradual transgression of the formations northward the Raritan ultimately rests upon the Piedmont Plateau of New Jersey, while southward the transgression of the Tertiary gradually buries the higher formations, the Raritan disappearing near the latitude of Washington.

The character of the Potomac basin of deposition is shown by well borings which indicate a distinct rise in the level of the Potomac surface in the Delaware peninsula.

'The Correlation of the Coal Measures in Maryland,' by W. B. Clark and G. C. Martin.

The Maryland Coal Measures have hitherto been largely studied independently of the same deposits in adjacent regions in Pennsylvania and in West Virginia, and as a result an independent classification has gradually been developed. The authors find, however, that not only the stratigraphic sequence but the fossiliferous horizons are identical with those in the adjacent regions of Pennsylvania and West Virginia, and they consider that the same classification should obtain. In the case of the lower members of the Coal Measures continuity of strata can be established, while even in the independent synclinal trough of the Georges Creek basin there is found the same sequence of strata and fossils. Numerous detailed measured sections were described in substantiation of these conclusions.

'A Reconnaissance of Mt. Hood and Mt. Adams,' by H. F. Reid.

These mountains belong to the group of volcanic cones built up mainly in Tertiary times along the line of the Cascade Range. Though probably extinct, steam and gases still issue in small quantities from cracks near the summits. The mountains consist of massive lava and lapilli, the latter being more abundant on Mt. Hood and the former on Mt. Adams. Some of the later lava-flows are probably not more than a few hundred years old. A number of parasitic cones are found on the flanks of Mt. Adams, two, at least, with well-marked craters, while none occur on Mt. Hood. About one half of the original crater wall of Hood still remains, the southern half having disappeared. The summit of Adams is long and broad. The stratification seen in the cliffs on the sides of the mountain suggest that there were several craters which may have been active at the same time or successively.

Many interesting glaciers lie on the slopes of both mountains; but they do not descend into the valleys. In several cases the depressions outside the lateral moraines are apparently quite as deep as the bed of the glaciers, and the cañons formed below the ends of the ice are deeply eroded, in strong contrast to ice-covered parts of the mountains. The main erosion has been effected by water, and the ice and snow, by preventing the concentration of the water, have protected the underlying rock.

There is little indication of a much greater extension of the glaciers of Hood in former times, but on Adams glacial scratches abound in positions not now reached by the ice.

'Recent Work in the Piedmont Area of Northern Maryland,' by Edward B. Mathews.

Areal mapping of the Piedmont Plateau in northeastern Maryland has been carried on during the last three years by the speaker, Miss F. Bascom and Mr. A. Johannsen. The formations present an intricate intermingling of igneous and metamorphic rocks comprising monzonites, gabbros, metarhyolites, and serpentines among the igneous rocks; and gneisses, quartz-schists, phyllites and slates among the metamorphosed sedimentary rocks.

The sequence of eruptions in the region is believed to include two periods, representing differentiated portions of an original magma of medium acidity. One formed the monzonites and was itself somewhat differentiated during the period of consolidation, monzonite; the second formed the gabbros, with the accompanying quartz-gabbros, norites and peridotites produced by secondary differentiation.

All of these have been intruded into the mica-gneiss which is either of early Paleozoic or pre-Cambrian age.

'The Miocene Formation of Maryland,' by G. B. Shattuck.

In the differentiation of the Chesapeake group, three well-defined formations are recognized, which are described from below upward under the names of Calvert, Choptank, and St. Mary's formations. An unconformity occurs between the Calvert and the Choptank. Well defined lithologic features mark the several formations, which have been mapped in great detail throughout southern and eastern Maryland. Each formation has its clearly defined fauna.

'The Pleistocene Problem in Maryland,' by G. B. Shattuck.

The gravel deposits of the North Atlantic Coastal Plain are divisible into five formations, which are known, beginning with the oldest, as the Lafayette, Sunderland, Wicomico, Talbot and Recent. The Lafayette has been doubtfully referred to the Pliocene; the Sunderland, Wicomico and Talbot are believed to be Pleistocene.

Each of these formations is developed in a distinct terrace which is separated from the adjacent terraces both above and below by well-defined scarps. These terraces lie one above the other, the oldest occupying the top of the series, and the youngest the bottom.

The agencies which have been instrumental in cutting the scarps and depositing the materials of the various formations are marine, estuarian, fluviatile and possibly subaerial.

The North Atlantic Coastal Plain underwent numerous changes in altitude while the various formations were building. They are briefly as follows:

1. Subsidence and deposition of the Lafayette.
2. Elevation and erosion of the Lafayette.
3. Subsidence and deposition of the Sunderland.
4. Elevation and erosion of the Sunderland.
5. Subsidence and deposition of the Wicomico.
6. Elevation and erosion of the Wicomico.
7. Subsidence and deposition of the Talbot.
8. Elevation and erosion of the Talbot.
9. Subsidence and deposition of the Recent.

The subsidence appears to be still in progress.

F. L. RANSOME,
Secretary.

BIOLOGICAL SOCIETY AT WASHINGTON.

THE 365th regular meeting was held on Saturday evening, May 17.

Arthur H. Howell spoke on 'The Summer Birds of Mt. Mansfield, Vermont,' describing the fauna and flora of the region at some length, and stating that the flora in particular was characterized by the presence of a number of plants customarily found farther north. The paper was illustrated with lantern slides showing characteristic features of the region as well as some of the birds.

W. W. Cooke discussed 'Bird Migration Routes,' paying special attention to the theory that in crossing considerable bodies of water birds either followed along existing islands, or where islands or direct land connection had formerly existed. The speaker gave the results of long and careful observation of many migratory North American birds, and showed that in passing from our southern States to Yucatan and Central America, or in returning, the small birds passed directly over the Gulf of Mexico where there had never been land. Very few of our birds either wintered in Cuba or passed through it while migrating, while the popular idea that birds passed from North to South America along the Windward and Leeward Islands was entirely incorrect. Neither, as far as could be ascertained, did birds follow certain routes, or 'lanes,' in their migrations, but covered a wide area. V. K. Chesnut exhibited a number of slides showing various poisonous plants of the west, giving their Indian names and uses. F. A. Lucas showed slides of the large Claosaurus skeleton at Yale, stating that it was the first complete Dinosaur skeleton mounted in this country.

F. A. LUCAS.

SECTION OF ANTHROPOLOGY AND PSYCHOLOGY OF THE NEW YORK ACADEMY OF SCIENCES.

AT a meeting on April 28 a paper entitled 'Two Experiments in Color Vision' was presented by Professor Robert MacDougall, and in his absence was read by title. He has found (1) that the subjective intensity and saturation of a given constant objective color increases with the retinal area illuminated by it. This increase is most marked in case of green, least marked in case of red. A similar phenomenon appears in the grays. The apparent difference in brightness between a patch of gray and a light or a dark background is increased by enlarging the patch. (2) A given area of illumination produces a stronger subjective effect when this area is divided and distributed over the retina than when it is compact. This is perhaps because the area of irradiation is increased by distributing the area of illumination.

Professor J. E. Lough reported some experiments on the memory of school children. He had tested 682 schoolgirls ranging in age from 9 to 15. The method employed was the same as that used by Lobsien in a similar investigation of the school children of Kiel. A list of ten words was read to the pupils who then wrote down as much of the list as they could remember. This was repeated with new classes of words until eight lists had been given. These experiments show: (1) That memory improves but slightly between the ages 9 and 15, being 62 per cent. at 9 and 64 per cent. at 13 and 15. This is in sharp contrast with the results obtained by Lobsien—38 per cent. at 9 and 75 per cent. at 13. (2) That the amount remembered depends upon the class of words composing the list—names of colors having an average of 87 per cent., names of concrete things 75 per cent., words connected with tactile experiences 70 per cent., emotions 68 per cent., sounds 58 per cent., abstract words 50 per cent., numbers 45 per cent. (3) That the usual retardation at 12 with acceleration at 13 is shown in each class of words, with the exception of emotions, where there is a marked retardation at 13, with acceleration at 14. (4) That in each of the lower grades of school (4A–5B) the brighter pupils have the better memory, while in each of the higher grades (6A–7B) the duller pupils have the better memory.

In discussing this paper, it was remarked by Professor Thorndike that grammar school girls of 14 to 15 do not fairly represent all girls of that age, since the brighter individuals are apt to leave the grammar school before reaching 14 years.

Professor Cattell, in a paper on the 'Intensity of Light and the Error of Perception,' described experiments in which 211 shades of gray between white and black were sorted out into the order of brightness. The steps were smaller than can be perceived, and there was consequently an error of displacement, measuring the just observable difference. For the more accurate observers the error was six cards or about 0.03 of the range between white and black. Observers differ within the extremes of about 1:2. The just observable difference increases with the magnitude of the stimulus, but not in direct proportion as required by Weber's law. The increase is more nearly in proportion to the square root of the magnitude, which the speaker has found to hold in other cases and has elsewhere attempted to explain.

Professor E. L. Thorndike presented results bearing on the question of 'Sex Differences with Respect to Variability.' A large number of psychological tests of school children has afforded him the opportunity of comparing the variability of boys and girls, as classes, and, on the whole, there is practically no difference between them.

Dr. W. Borgoras reported some results of his recent observations, undertaken for the Jesup North Pacific Expedition, in northeastern Siberia, among the Chuckchi, Koryak and Kamchadal peoples. These he found to resemble each other strongly in the structure of their languages and in their folklore. What is especially interesting is the striking similarity, almost identity, between some of their traditions and some of those current among the North American Eskimos and the Indians of British Columbia. It is not, however, the Asiatics living nearest to Bering Strait, but more southerly tribes, that show most evidence of kinship with the Indians.

R. S. Woodworth,
Secretary.

TORREY BOTANICAL CLUB.

At the meeting of April 30, held at the Botanical Garden, the first paper was by Dr. C. C. Curtis, on 'Some Features connected with Transpiration.'

Transpiration may be illustrated by a fluctuating curve. The maximum of the curve is found in the forenoon and corresponds to the periodicity in the stems. Transpiration can hardly be considered to be wholly a physical property. The volume of water given off by plants in the night is very considerable, and probably the stomata are never completely closed. It seems perfectly rational that the stomata are open, partly, in the dark, and that some transpiration takes place. During the early morning hours, the amount of water given off is much more than in the afternoon, as the stoma has become used to the light.

Another paper was by Professor F. E. Lloyd, on 'Compound Leaf Forms.' In many cases, when a leaf is lobed, or has one lobe, the leaf on the opposite side of the stem also has a lobe on the opposite side of the midrib. This may be seen in the bud as well as in full grown leaves; as in the pear, elm, etc.

The fourth paper was by Dr. H. M. Richards, on 'Turgor Changes in Injured Tissues.' It has been shown that the curved respiration in injured plant-tissues rises for a time and then falls off to the normal. The 'wound-fever,' or 'rise-in-temperature' curve is similar to that of respiration. Turgor changes apparently accompany these reactions towards injury. The onion was used for experiment, and the wounded and uninjured bulbs were placed in a saturated atmosphere. The normal turgor pressure in terms of KNO_3 solution is about 3.5 to 4 per cent.; after wounding this falls about 0.5 per cent. As the heating goes on, four or five days after the wounding, the turgor has increased again, and the wounded and unwounded onions are practically the same in this respect. Carrot, beet and radish were also used.

Dr. MacDougall exhibited plants of *Monotropsis odorata* sent by Professor Johnson, of Johns Hopkins. He also showed a basket made by the Pima Indians of Mexico, made of *Typha, Martynia* and *Salix*. He also exhibited the ayal or calabash fruit from Sonora, of the genus *Crescentia*, a fruit of economic importance.

Miss Angell, of Plainfield, New Jersey, exhibited living plants of *Viola Angellæ* in flower. When the plant is flowering the scapes exceed the leaves; but later in the season the leaves overtop the scapes.

S. H. BURNHAM,
Secretary pro tem.

UNIVERSITY OF WISCONSIN SCIENCE CLUB.

AT the monthly meeting of the club, held May 6, three papers were presented.

Professor Wm. H. Hobbs discussed the newly discovered Algoma meteorite. It was ploughed up in Ahnapee Township, Kewaunee County, Wisconsin, in 1887, and was recognized as a meteorite in March, 1902, when presented to the University of Wisconsin. It is an octahedral siderite weighing a little less than nine pounds. Its shape is that of an elliptical shield less than an inch in thickness. Its convex surface is fairly smooth, but exhibits strongly marked 'drift' markings consisting of radial striæ upon the front which proceed from a central flat boss to the periphery, slightly curving to form a lævo-rotatory spiral. Its concave surface is irregular and crusted. These facts indicate that the meteorite moved 'broadside on' through the atmosphere with its convex surface to the front. Casts of the meteorite in plaster may be obtained by museums and persons interested.

Professor C. S. Schlicter described the manner of flight through the atmosphere of a meteorite of the shape of the Algoma meteorite. A meteorite, discoidal in shape and possessing a rapid motion of rotation about its shortest axis, undergoes the following changes in its motion upon entering the atmosphere. The first effect of the impact is to give to the spinning body a motion of precession similar to that of a gyroscope. The next effect is the lessening of the angle of the cone described by the precessing axis, an effect entirely analogous to the 'sleeping' of a common top. In consequence of this the meteorite advances through the atmosphere with its flat side presented to the resisting medium.

Professor C. E. Mendenhall presented a paper entitled 'The Measurement of Radiant Heat.' The theory of the more important instruments for infra-red research—namely, the bolometer, thermopile, radiometer, radiomicrometer and pyrheliometer—was discussed, and examples of most of the instruments exhibited. The radiomicrometer, thermopile and pyrheliometer were shown in actual operation, and by means of the first named instrument arranged for projection the infra-red spectrum of a Nernst lamp was explored.

C. K. LEITH,
Secretary.

DISCUSSION AND CORRESPONDENCE.

NORTHWESTERN AMERICA AND NORTHEASTERN ASIA.* A CRITICISM.

THE current number (48, 1902, III., pp. 49–58) of Petermann's *Mitteilungen* contains an article of some length entitled 'Nordwest-Amerika und Nordost-Asien. Geographische Wechselbeziehung,' by Capt. Fr. Immanuel, which purports to be a brief summary of the most authentic information pertaining to the geography and mineral resources of the adjacent portions of the Asiatic and North American continents. Most of the article is devoted to Alaska, and to this part I desire to offer some criticism. Capt. Immanuel, in common with many compilers, has fallen into

* Published by permission of the Director of the U. S. Geological Survey.

errors which one who had a personal familiarity with the region under discussion would have avoided. In his compilation he has not only included many statements which were based on unreliable authorities, but has totally misinterpreted the results of such investigators of the region as Dr. George M. Dawson. It is my purpose to point out some of the more glaring errors contained in this article, so that they may not become current in geographical literature.

The description of the northern Rockies, the St. Elias and Alaskan ranges, as composed of a series of volcanic peaks, hardly deserves comment, especially as they are described as a coastal fringe of volcanoes and compared with the volcanic peaks of the Japanese and Philippine Islands. A less apparent and therefore more serious blunder is the grouping together, as one range, of the Cascade, the St. Elias and the Alaskan ranges. The recent volcanoes of the Aleutian islands and the Alaskan peninsula are described as a southwesterly continuation of the volcanoes of the St. Elias and Alaskan ranges. As a matter of fact, the Alaskan range, so far as now known, is an entirely distinct feature, both geologically and geographically considered, from the belt of volcanoes which separates the Bering Sea from the Pacific ocean. The southwestward extension of the St. Elias range is found in the highlands of the Kenai Peninsula.

According to Capt. Immanuel, the glaciation of northwestern America was produced by an ice sheet which had its source in the high mountains of Greenland and moved westward across the lowlands of the northern part of the continent. He states that this ice sheet impinged on the Rocky Mountain front, and was split into two divergent glaciers, of which the southern one passed southward through the Columbian depression and into California, while the northern descended the Yukon valley. The ice sheet, during its long journey, is supposed to have ground up the auriferous quartz veins over which is passed, and their gold contents to have been deposited in the places now found in the Klondike and Nome regions. This astonishing theory is credited to Dawson and other American investigators. It is bad enough to have a statement of this nature appear in what purports to be a scientific article, but to credit it to American geologists, especially to such a thorough scientific investigator as Dawson, is the last straw.

The author in the course of the article shows himself to be as unreliable in regard to details as he is incapable of treating the broader geographic and geologic problems. For instance, he has given figures on the output of the Nome gold fields for two years, and in both cases these figures are a million or more dollars in error. For this there is no excuse, as official statements in regard to this production are in print.

The map of the Seward Peninsula which accompanies the paper, is a reproduction of one which was published in a recent report* of the U. S. Geological Survey. To this map, Capt. Immanuel has taken the liberty of adding some axes of mountain ranges of which there is no mention made in the original report. As the latter contains the results of the only surveys which have been made in the Seward Peninsula, it is impossible that there should be any authority for making these changes in the map.

There are many other misstatements which might be pointed out in this article, but I think I have given enough to show that it is an aggregation of glaring inaccuracies and faulty generalizations. Had it appeared in a lesser publication than Petermann's *Mitteilungen,* it would not have been worthy of consideration, but published as it was in one of the leading geographical journals of the world, it seemed to me that for the sake of geographic science attention should be called to its dilettante character.

Alfred H. Brooks.

VOLCANIC DUST.

To the Editor of Science: Analysis of some mineral dust from the Martinique erup-

* Apparently through an oversight, the report, entitled 'A Reconnaissance of the Nome and adjacent Gold Fields,' was omitted from the list of authorities quoted in this article.

tion is subjoined. The sample examined fell on board of the *Alesandro del Bueno,* a vessel distant at the time about one hundred miles from the scene of the disaster at St. Pierre.

Silica	53.34%
Sesqui-oxides of iron and aluminium	30.68 "
Calcium oxide	10.47 "
Magnesium oxide	4.12 "
Sulphur	0.17 "
Phosphorus	trace

The powder is highly magnetic; in all probability some of the iron present is magnetite.

F. G. WIECHMANN.

THE SUBDERMAL MITE OCCURRING AMONG BIRDS.

TO THE EDITOR OF SCIENCE: The interesting observations of Mr. Beebe (SCIENCE, May 9, 1902) require some additions, since the only author to whom he has referred gives by no means a complete statement regarding the character or occurrence of the mite. A form very similar if not identical with this has been reported a number of times: H. Garman, 1884, Leidy, 1890, and Kellicott, 1892, have noted its occurrence in various hosts in America, and it has been studied carefully by several investigators in Europe. In a paper published in *Psyche* (Volume VIII., pp. 95–100) I have given a discussion of the genus and its life history, together with a full bibliography up to that date.

It is probable that the mites found by Mr. Beebe are simply stages in the life history of some of the plumicolous sarcoptids. It may be seriously doubted whether the inferences drawn from Mr. Beebe's observations, that these mites were the cause of death of the birds noted are sufficiently well grounded. Certainly similar stages occur frequently in pigeons without apparently affecting their vitality and I should also doubt that the treatment advocated by Mr. Beebe would be likely to yield the results desired. It is altogether probable that a reduction in the number of feather mites would be accompanied by a reduction in the number of these subdermal larvæ, but the view of Mégnin is well known whereby the plumicolous sarcoptids are to be grouped as symbionts rather than as parasites by virtue of the assistance they afford to the host in keeping the surface of the skin and feathers free from débris.

HENRY B. WARD.

AN INTERESTING INVITATION.

IT is not long ago that there were people who maintained very stoutly that there existed an irrepressible conflict between religion and science. Undoubtedly there have been and there will continue to be conflicts between sciolism and religiosity. Men who are possessed of scientific truth, but lack religious or theological information of high order, may in time to come, as they have in times past, imagine that their views are antagonistic to religion; and conversely men possessed of religious truth or half truths will no doubt arise in the future, as they have in the past, who will aver that the knowledge which they have is in conflict with scientific propositions held by others. People who see only one side of a subject are given to logomachy, and if they are Scotch, or Scotch-Irish, to heated controversy. They cannot help it. In the end neither religion nor science suffer much from the squabbles which their disputatious tempers create.

It is a pleasing incident in connection with the coming meeting of the American Association for the Advancement of Science, that on March 24, 1902, the Federation of Churches of Pittsburgh, Allegheny and vicinity, held a meeting and adopted unanimously the following resolutions:

"Inasmuch as all truth is one and is divine and inasmuch as all organizations for its conservation and propagation are kindred, the Federation of Churches of Pittsburgh, Allegheny and vicinity records its pleasure in the fact that the A. A. A. S. is to hold its anniversary in Pittsburgh this year.

"In behalf of the Churches we desire a large and representative meeting here of the Seers and Prophets of Science.

"In behalf of those interested in the advancement of education and knowledge, we extend to them a hearty welcome."

It is plain from these resolutions that the clergy of these most orthodox, most order-loving, and church-going cities are not afraid of their scientific brethren. They have even gone a step further, and they extend to the members of the American Association for the Advancement of Science a cordial invitation to occupy so far as possible the pulpits of their churches on the morning and evening of June 29. It is sincerely hoped that this invitation will he heeded and that a number of the members of the Association will avail themselves of the opportunity to present to the large and intelligent audiences, which will greet them, such phases of scientific truth as may be appropriately presented before worshiping assemblies. As Chairman of the Local Executive Committee charged with making arrangements for the coming meeting, and on behalf of the clergy of the city, I desire by special request to urge those who are coming to the meeting to bring with them addresses of such a character as they may feel inclined to present, and if they will notify me in advance—which I hope they will do—of their willingness to address such audiences, we will arrange with the clergy for the assignment of such speakers to various pulpits. Scientific men as well as clergymen have 'barrels,' and I trust that not a few will open up their barrels before coming to the meeting and bring with them from their treasure houses 'things new and old' which the good people of these cities will be glad to hear.

W. J. Holland.

SHORTER ARTICLES.

HENRI FILHOL, PALEONTOLOGIST.

By the death of Henri Filhol, French paleontology has suffered a severe loss. As a successor of the school of de Blainville and contemporary of Professor Albert Gaudry, he has rendered distinguished service, especially in his originality as an explorer of the famous deposits of the Phosporites du Quercy, terminating in his volumes published in 1877, and of the Upper Oligocene, Saint-Gérand le Puy, published in 1879. Continuing this line of research he explored the Lower Oligocene of Ronzon, publishing his results in 1880. These larger volumes together with several memoirs and a very numerous series of preliminary papers have greatly enriched our knowledge, especially of the Oligocene fossil fauna of France.

One of the most important of his discoveries was a complete skeleton of the genus *Macrotherium*, formerly established upon the claws, proving that this animal was identical with the genus *Chalicotherium,* which had been established upon the teeth. It was thus found to represent an extraordinary combination of dentition affiliated to that of the ungulates, and feet apparently affiliated to those of the edentates. M. Filhol himself was disposed to regard this animal as a connecting form; but Cope immediately perceived that it represented a new phyla, and proposed for it the name *Ancylopoda.*

During the writer's last visit to Paris, he found M. Filhol devoting his time chiefly to building up a great collection of comparative osteology, which had been almost entirely neglected since the time of Cuvier. M. Filhol expressed his purpose as follows: 'I had found it impossible to study comparative osteology in the disordered state of the collections, and I determined that I would devote my time to an entire rearrangement, so that students coming to Paris would enjoy opportunities which had been denied me.' The beautifully arranged hall, presenting all the remarkable variations, especially of the mammalian skeleton, will therefore be the monument of M. Filhol's later years.

The superb collections of fossils which he made will, it is hoped, soon be acquired by the state and placed on exhibition in the famous gallery of paleontology in the Museum of the Jardin des Plantes.

H. F. O.

CERTAIN PROPERTIES OF NUCLEI.

In an extended series of experiments, made by shaking dilute solutions of the order of 1 per cent., .01 per cent., .0001 per cent. by weight, and a variety of solutes like HCl,

H_2SO_4, NaCl, $CaCl_2$, $FeCl_3$, $Fe3NO_3$, $Al3NO_3$, $Ca2NO_3$, $(H_4N)NO_3$, alum, Na_2SO_4, etc., and neutral organic bodies like sucrose, glucose, glycerine, urea, etc., I reached a number of new results, to one of which, in particular, I will venture to call attention here.

1. The number of nuclei produced under identical conditions of agitation varies with the violence of the agitation and the bulk of solution used, and from a theoretical point of view, particularly with the concentration of the solution and its chemical nature. Thus under given identical conditions of shaking one may get from water about 30 nuclei per cubic centimeter; from 1 per cent. $CaCl_2$ solution, 240 nuclei; from 1 per cent. Na_2SO_4 solution, 450 nuclei, etc.; from 2 per cent. sugar solution, 157 nuclei; from 2.6 per cent. glycerine solution, 95 nuclei, etc. So far as concentration alone goes, one may write for dilute solutions, $n=n_0+A/(\log(B/C))$, where n is the number of nuclei produced per cu. cm. under otherwise like conditions, n_0 the number in case of infinite dilution (water), C the concentration and A and B constants. If absolutely pure water were available, it is probable that n_0 would vanish. One may note that the degrees of extreme dilution effective recall the sensitiveness of electrolytic experiments. For organic neutral solutes, the number of nuclei is not only smaller as a rule, but they are characteristically fleeting.

2. The point with which I am concerned, however, is the rate at which the nuclei vanish in the lapse of time. From the marked diffusion of these nuclei, their dimensions must be comparable with molecular dimensions. Subsidence is out of the question. If, as I interpret it, the loss of nuclei in the lapse of time is due to absorption at the solid walls of the spherical receiver, one may write for the absorption velocity, k (meaning that kn nuclei are absorbed per square cm. per minute), $k=-(R/3n)(dn/dt)$. Computing k in this way (essentially $d(\log n)/dt$), one finds from all the solutions, saline or neutral, an important general result: For the case of solutions of a few per cent. (1 to 3), k is of the order of .02 to .04 cm./min., though varying from solute to solute; for the .01 per cent. solutions k is of the mean order of 08 cm./min.; for the .0001 per cent. solutions, k is of mean order of about 8 cm./min.; for ordinary distilled water, in glass vessels, k may reach 5 cm./min., etc. I have the specific data in hand, but do not wish to weary the reader.

It follows therefore in general, that not only does the number of nuclei produced by shaking (*cœt. par.*) increase with the concentration of the dilute solution, but the apparent rate of decay of nuclei diminishes, *i. e.*, their absorption velocity decreases with the strength of the solution. For ordinary distilled water, these velocities, *if referred to three dimensions*, are already beginning to approach the ionic velocities. Again as the number of nuclei, n, is greater, they vanish more slowly, so that an apparent decay increasing with the density of the nucleation is out of the question. The whole, therefore, constitutes an entirely new and striking corroboration of the isolated point of view taken throughout my work.*

3. The inference is therefore tenable that the nuclei shaken out of stronger solutions are larger. Since the nuclei are produced by evaporation from a large diameter, it follows that the dimensions at which evaporation ceases at the surface of the particle are larger for the stronger than for the weaker dilute solutions. Naturally a given degree of concentration is reached in a larger globule in the former case than in the latter. The theory for the production of the nuclei here in question is thus at hand. A particle of absolutely pure water produced by shaking will either vanish by complete evaporation, or it will grow and eventually vanish by subsidence. If, however, the evaporating globule is a solution, the increment of vapor pressure at the surface of increasing convexity will gradually be compensated by the decrement of vapor pressure due to the increasing concentration of the solution. Hence there must be a critical diameter at which the increased vapor pressure due to surface tension just counterbalances the decreased vapor pressure due to concentration. This is the stable diameter of the nucleus. A smaller particle will grow because the concen-

* Compare 'Experiments with Ionized Air,' p. 92, Smithsonian Contributions, Washington, 1891.

tration effect supervenes; a larger particle will evaporate because the effect of surface tension supervenes.

4. In connection with this simple mechanism for producing stable nuclei of a startling degree of smallness by mere shaking, nuclei which may be without electrical charge, the question naturally arises whether the mechanism is not sufficient to account for nuclei in the presence of saturated vapor, in general.

Suppose therefore that such chemically powerful agencies as the X-rays, or Becquerel rays, or ultra-violet light, or the electric glow, etc., on being passed through a saturated vapor, produce in that vapor a new chemical synthesis in degree, however small (fancy the vapor pressure due to a few hundred nuclei per cubic centimeter!), soluble in the liquid from which the vapor arises. Then immediately around the new molecule there will be a region of vanishing vapor pressure. The new molecule (or ion) will therefore grow by condensing the vapor, until further growth is arrested by the decrement of vapor pressure due to diminishing convexity. In other words, the critical diameter is again reached.

C. Barus.

Brown University,
Providence, R. I.

QUOTATIONS.

THE APPLICATIONS OF ELECTRICITY IN GREAT BRITAIN.

The Institution of Electrical Engineers appointed, about a year ago, a committee to inquire into electric legislation and to recommend, if possible, such action as might assist the electrical industry. Some three weeks ago we gave the general conclusions of the committee, as embodied in a number of resolutions. Its report has now been issued, with a large amount of interesting evidence, extracts from which we publish to-day. There are practically no dissentients from the opinion that electrical enterprise is in a very backward condition in this country. The fact may be differently explained by different people, and no doubt, more than one cause may fairly be assigned. There are a few who rather glory in our backwardness, and try to persuade us that other nations have lost money by going ahead. But however the fact may be explained or regarded, it is universally admitted. In the use of electricity for traction, for lighting, and for the economical supply of power for manufacturing purposes, we are far behind other nations. So much is this the case that, when any demand arises for generating machinery and plant, it is found that there has been no previous demand of such a kind as to produce manufacturers with the requisite appliances and experience. An electric railway or tramway company has to import machinery from America or Germany, because it cannot be supplied at home, or, if supplied at all, is produced with extreme slowness. Things are, no doubt, improving in that respect, though it is not altogether agreeable to reflect that the improvement is largely due to American enterprise. The public are mostly concerned in noting the phenomena of traction and lighting. Yet it may be taken as certain that a far greater aggregate loss to the nation arises from the failure to take due advantage of the immense economy in the production and transmission of power that electricity offers when intelligently applied. The committee finds that the main cause of our backwardness is stupid and restrictive legislation, carried out by legislators having no knowledge of the subject they had to deal with, and allowing themselves to be guided by abstract political or economic theories. In other countries rulers called upon to deal with questions of this kind habitually consult men of science and frame their regulations with some regard to the special nature of the subject-matter. In other words, different forms of national intelligence are coordinated for the national good.—The London *Times*.

CURRENT NOTES ON METEOROLOGY.

MONTHLY WEATHER REVIEW.

The Monthly Weather Review for January (issued April 11), the first number of Vol. XXX., is somewhat changed in external appearance, and the name of Mr. H. H. Kimball as assistant editor is associated with that of Professor Abbe. There is a distinct improvement in the quality of the paper used, but the general arrangement of the contents remains the same. This number contains the usual titles of recent meteorological papers (we may note that SCIENCE is not published in London, as stated in the *Review*, but in New York), and among the more noteworthy articles the following may be mentioned: Professor F. H. Bigelow: 'A New Barometric System for the United States, Canada and the West Indies' (see SCIENCE, March 14, 1902, 417–421), this being the first of a series of 'Studies on the Statics and Kinematics of the Atmosphere in the United States'; Albert Matthews: 'The Term Indian Summer,' an interesting historical sketch, with copious bibliographical notes; B. C. Webber: 'January Gales from the Great Lakes to the Maritime Provinces' (Mr. Webber being Inspector and Forecast Official of the Meteorological Service of Canada); an account of the work of the Weather Bureau in the West Indies; a short 'History of Meteorological Work in India'; a report on the Third International Congress on Hail Shooting, and a translation of Professor J. R. Plumandon's 'General Report on Hail Shooting,' presented to this Congress. Anyone interested in keeping up with the progress of meteorology will find the *Monthly Weather Review* indispensable. Next to the *Meteorologische Zeitschrift* it is the best general publication on meteorology now issued.

SOME PHYSIOLOGICAL AND OTHER EFFECTS OF SUNSHINE AND SHADE.

SOME very interesting facts regarding certain effects of varying exposures to sunshine are brought out in a recent paper by M. Lugeon, professor at the University of Lausanne, entitled 'Quelques Mots sur le Groupement de la Population du Valais (Etrennes helvetiques pour 1902). A study of the principal valley of the canton, between Martigny and the Rhone Glacier, brings out some evident effects of exposure. Statistics show a population of about 20,000 on the left bank, and 34,000 on the right bank of the river. A part of this difference is doubtless due to the fact that the right bank is less steep, and hence more open to settlement, but the major part is believed by M. Lugeon to result from the difference in the exposure to sunshine. In a certain district in this same valley the slopes on both sides are about equally steep, but the population on the sunny side is about 3,000, while that on the shady side is between 700 and 800. With one or two exceptions, all the villages are on the sunny side. In fact, a certain distinction of classes results from this difference in the conditions of insolation. There is developed an aristocracy of the sun, so to speak. The people who live on the right bank are on the whole more prosperous, and better educated. They of the *Sonnenseite* look with some contempt upon the poor people on the *Schattenseite*. The village of Reckingen contains two real castes, the distinction between which rests ultimately upon the difference in exposure to sunshine.

METEOROLOGICAL ANNUAL OF THE ROYAL BELGIAN OBSERVATORY.

The Annuaire Météorologique of the Royal Observatory of Belgium for 1902 is a useful publication, containing a large amount of tabular matter relating to the meteorology of Belgium for the year; meteorological conversion tables, etc., and two longer articles, one a historical sketch of meteorological work in Belgium, and the other an excellent account of the exploration of the free air, and of the results thus far obtained.

R. DEC. WARD.

HARVARD UNIVERSITY.

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*THE WEST INDIAN ERUPTIONS AND SOLAR ENERGY.**

IN 1883, in connection with the eruption of Krakatoa, you were good enough to allow me to appeal through your quickly and widely circulated columns for early information to enable me to test an idea connected with the spread of the glorious sunsets round the world which followed the event.

Because the terrible catastrophies in Martinique and St. Vincent occurred at a well de-

* A letter addressed to the editor of the London *Times* by Sir Norman Lockyer.

fined sunspot *minimum* I was led to inquire whether similar coincidences were to be traced in the past. I did not know then, but I know now, that Wolf, exactly half a century ago, had suggested a connection between solar and seismic activity; in his time, however, the record of solar changes was short and imperfect.

In my own inquiry I have used our most recently compiled tables, which are now complete for the last 70 years, and I have only considered seismic disturbances within that period. I find beyond question that the most disastrous volcanic eruptions and earthquakes, generally occur, like the rain pulses in India, round the dates of the sunspot *maximum* and *minimum*. More than this, the 35-year solar period established by Dr. Lockyer, which corresponds approximately with Bruckner's meteorological cycle, can also be obviously traced, so that, indeed, the intensification of the phenomena at the *minimum* of 1867 is now being repeated.

In 1867, Mauna Loa, South America, Formosa, Vesuvius were among the regions involved; in the West Indies it was the turn of St. Thomas. The many announcements of earthquakes in the present year before the catastrophe of St. Pierre will be in the recollection of everybody.

In the *maximum* in 1871-72, to name only West Indian stations, Martinique first and then St. Vincent followed suit; in the next *maximum*, in 1883 came Krakatoa.

At Tokio, in a country where the most perfect seismological observatories exist, we find that at times near both sunspot *maxima* and *minima* the greatest number of disturbances have been recorded.

Very fortunately, the magnificent work of the Indian Meteorological Department enables us to associate the solar changes with pressures in the tropics, and obviously these pressures have to be taken into account and carefully studied.

This, sir, brings me to the point of this letter, which is, through your kindness, to ask from meteorological observers in the West Indies and the surrounding regions the favor of copies of their barometrical readings, showing the departures from the local means for the two months preceding the eruption at St. Pierre. In this way one or two years may be saved in getting at the facts.

SCIENTIFIC NOTES AND NEWS.

At the annual meeting of the American Academy of Arts and Sciences, held on May 14, it was voted to award the 'Rumford Premium' to Professor George Ellery Hale of the Yerkes Observatory, 'for his investigations in solar and stellar physics, and in particular for the invention and perfection of the spectro-heliograph.' It was also voted to appropriate the sum of $750 from the income of the Rumford Fund to be expended for the construction of a mercurial compression pump designed by Professor Theodore W. Richards and to be used in his research on the Thomson-Joule effect. An appropriation from the Rumford Fund was also made to Professor Arthur A. Noyes in aid of his research upon the effect of high temperatures upon the electrical conductivity of aqueous solutions.

Dr. Angelo Heilprin, of Philadelphia, and Mr. George Kennan are among those who are engaged in studying the volcanic eruptions in the Lesser Antilles. They, as well as Dr. R. T. Hill, according to the reports in the daily papers, have made a thorough examination of the conditions in Martinique, having explored that the Government will defray the expenses.

The Paris Academy of Sciences will send a scientific mission to investigate the volcanic eruptions in the Lesser Antilles. The mission will probably sail on June 9. It is understood that the Government will defray the expense.

An expedition to study the volcanic eruptions in the West Indies is also planned by Great Britain under the auspices of the Royal Society. It is expected that Dr. Tempest Anderson and Dr. Flett, of the Geographical Survey, will be members of the party.

A scientific Commission consisting of Dr. G. C. Low, Dr. C. Christy and Dr. Castelani has been sent to Uganda by the Royal Society for the purpose of investigating sleeping sickness.

MR. C. CROSSLAND and Mr. J. S. Budgett have received grants for zoological research in Africa from the Balfour fund of Cambridge University.

CAPT. J. S. PRATT, of the U. S. Coast and Geodetic Survey, is preparing for his annual cruise in northern waters on the United States steamer *Patterson*.

FOREIGN exchanges state that Professor Rudolf Virchow is now going through a 'cure' at Teplitz-Schonau, where he is under the care of Dr. Hirsch. He is able to walk about with support, sometimes using only one crutch. He is regaining power over the injured limb, being able to lift the left leg so as to place it across the right knee. His general condition is also much improved.

DR. S. KIMURA, surgeon inspector of the imperial Japanese navy, is at present in this country, where he will spend three months examining the medical and hygienic arrangements of our navy.

THE University of Cambridge will on June 10 confer the degree of LL.D. on Mr. F. S. R. Bell, of the Canadian Geological Survey.

THE prize of the Otto-Vahlbruch foundation at Hamburg has this year been awarded to Dr. Ludwig Boltzmann, professor of physics at the University of Leipzig. The value of the prize is about $2,400.

THE Rolleston Memorial Prize, awarded at Oxford University for original research in morphology, has been given to Mr. Francis J. Cole, of Jesus College.

SIR WILLIAM TURNER THISTLETON DYER, director of the Kew Botanical Gardens, has been appointed botanical adviser to the secretary of state for the colonies.

THE degree of M.A. has been conferred by Oxford University on Andrew L. Herbertson, Ph.D. (Freiburg in B.), lecturer in regional geography, and on Henry N. Dickson, B.Sc., New College, lecturer in physical geography.

CAMBRIDGE UNIVERSITY has granted the degree of M.A. (*honoris causa*) to Mr. T. H. Middleton, professor of agriculture.

ON February 15 the Russian Medical Society celebrated the hundredth anniversary of the birth of its founder, Dr. Fedor Inosemzeff, who died in 1869. Dr. Inosemzeff was professor of surgery in the University of Moscow till his death.

A MEMORIAL erected by Edward Longstreth, of Philadelphia, to John Fitch, who is said to have been the first to apply steam to the running of a boat, has been erected in Warminster, Pa. It bears the inscription: "John Fitch here conceived the idea of the first steam-boat. He ran a boat with side-wheels by steam on a pond below Davisville in 1785. Bucks County Historical Society."

WE have already noted the unveiling of a bronze tablet at Lafayette College in memory of the late James H. Coffin. The inscription reads as follows: "In memory of James Henry Coffin, LL.D. Long a main-stay of Lafayette College, professor of mathematics, natural philosophy and astronomy, 1846-1873; vice-president and college treasurer, 1863-1873. A tireless teacher and administrator, an officer of the church, a friend of the slave. A member of the National Academy of Sciences, author of 'Winds of the Globe.' He annexed the atmosphere to the realm of science, and searched the highways of the winds and the paths of vagrant storms. Born in Williamsburg, Mass., September 6, 1806; died in Easton, February 6, 1873. The Class of 1866 has erected this tablet."

PROFESSOR ADOLF KUSSMAUL, the eminent German pathologist, who recently celebrated his seventieth birthday, died on May 27. Dr. Kussmaul is eminent for his work on aphasia and other forms of nervous disease.

MR. G. C. HUBBARD, assistant in the department of chemistry, Columbia University, died on May 26. Mr. Hubbard graduated from the School of Applied Science in 1900.

MR. ANDREW CARNEGIE has promised to duplicate all subscriptions up to $7,500 to the Hugh Miller Centenary Memorial.

MRS. COLLIS P. HUNTINGTON has given the sum of $100,000 to the General Memorial Hospital for the Treatment of Cancer and Allied

Diseases, New York, the income to be used for pathological research.

Mr. Edmund Oldfield, F.S.A., of Rushmore, Torquay, Honorary Fellow of Worcester College, Oxford, who died on April 11, last, bequeathed to the chancellor, masters and scholars of the University of Oxford his cabinet of antiquities, and various specimens of Greek, Roman and Etruscan art in marble, bronze and terra cotta, and he desired that they should be placed in the Ashmolean Museum and known as the 'Oldfield Bequest.'

The Royal Academy of Medicine of Belgium offers a prize of 800 francs for research on the anatomical relations of the neurons to each other.

The Royal Society held the first of its annual conversaziones on May 14, with, as appears from the official catalogue, a very interesting exhibit of new apparatus and methods. Of most general popular interest were perhaps the exhibits in color photography by Dr. R. D. Roberts, Sir H. Trueman Wood and Messrs. Samger Shepherd and Company. The photographs showing geological formations and photomicrographs of stained sections of tissues are of considerable scientific interest as giving results free from the personal equation of the artist. As has been usual in late years X-ray photographs appear to have been a prominent part of the exhibition. Other exhibits in physics were a new type of chronograph, in which the pens are moved instead of the drum, by Mr. R. L. Mond and Dr. Wilderman; the film structure of metals by Mr. George Bailey; an improved coal calorimeter by Mr. W. Rosenheim, and kites for meteorological purposes by Mr. W. H. Dines. The zoological exhibits included fossil mammals from Egypt, recently obtained by the Natural History Museum; the parasites discovered by Dr. A. Tylor in the blood of cattle in South Africa and by Mr. Everett Dutton in human blood, where symptoms occurred resembling those suffered by animals when bitten by the Tsetse fly. Photographs of the nebula surrounding Nova Persei were exhibited by Professor Hale, of the Yerkes Observatory.

The amount proposed to be expended in three years by Great Britain on North Sea fishery investigations, as the result of the Stockholm and Christiania Conference (including the share of the cost of the central bureau) is £42,000.

The American Congress of Tuberculosis is meeting this week in New York City. Among those expected to take part are Dr. Daniel Lewis, head of the Health Department of the State of New York; Dr. E. J. Barrick, of Toronto; Dr. J. J. Kinyoun, of Glendola, Pa.; Professor J. G. Adami, of McGill University, and Dr. D. E. Salmon, chief of the Bureau of Animal Industry, Department of Agriculture.

The American Institute of Electrical Engineers held its nineteenth annual meeting on May 20. Mr. Charles F. Scott was elected president to succeed Mr. Charles P. Steinmetz. It was reported that during the year the number of members had increased by 239 and the assets of the institute by nearly $15,000.

At the recent annual meeting of the Louisiana Society of Naturalists the election of officers for the ensuing year resulted as follows: *President,* W. R. Dodson; *First Vice-President,* E. M. Hudson; *Second Vice-President,* Miss Grace King; *Third Vice-President,* Ed. Foster; *Secretary,* R. S. Cocks; *Treasurer,* G. R. Westfeldt; *Executive Committee,* A. Richards, R. Rordam, Dr. Martin Feingold.

Plans have been prepared for the erection of a bacteriological laboratory in Washington, under the control of the Marine Hospital service. We noted last year the act of Congress appropriating $35,000 for this purpose, and setting aside five acres of ground from the reservation now occupied by the Naval Museum of Hygiene.

A central seismological laboratory has been established at Strassburg and placed under the charge of a board including Professors Becker (Strassburg), Credner (Leipzig), Futterer (Karlsruhe), Gerland (Strassburg), Helmert (Potsdam), A. Schmidt (Stuttgart), Wiechert (Göttingen), and von Zittel (Munich).

THE monthly general meeting of the Zoological Society of London was held on May 23, Dr. Henry Woodward, vice-president, in the chair. It was stated that there had been 173 additions made to the Society's menagerie during the month of April, among which special attention was directed to two pairs of the beautiful grey teal (*Querquedula versicolor*), of the Argentine Republic, obtained by purchase. After the proceedings of the usual monthly general meeting had terminated Professor J. Cossar Ewart delivered a lecture on 'Horses and Zebras.'

MR. EADWEARD MUYBRIDGE writes to the editor of the London *Times* as follows: In the new volumes of the 'Encyclopædia Britannica' is reproduced in the articles 'Egyptology' a tablet of Mena dating from the first dynasty, or about 4700 B.C., and is the oldest written sentence yet discovered. In 'A History of Egypt, by W. M. Flinders Petrie,' the author, referring to the Egyptian artists of the fourth dynasty, says: 'They did not make a work of art as such, but they rivalled nature as closely as possible.' Two figures—a bull and a deer—on the tablet of Mena afford a remarkable confirmation of the professor's statement, in regard to the knowledge and expression of motion by the sculptor of this age. A bull striving to attain his utmost speed is represented in a phase of movement, which after a lapse of 66 centuries is reproduced in a photo-engraving illustrating some consecutive phases in the stride of a horse, published in the 'Century Dictionary' under the heading of 'Gallop,' and in the 'Standard Dictionary' in its definition of 'Movement.' The phase employed by the Egyptian artist has been, until recent years, very rarely used in art; the nearest approach to it that I can at this moment recall is in a fresco painting on the walls of the Campo Santo at Pisa, supposed to have been executed at Pisano. It, like the Mena tablet, illustrates a phase of the transverse gallop—a system of motion adopted by the horse, the ox, and the greater number of animals, whether single toed, cloven or soft-footed, when they exert their utmost power to attain their highest speed. In the lowest line of figures on the tablet is a deer, evidently jumping over an obstacle. The animal is represented with all its legs, flexed, in pairs, under its body. A precisely similar phase may be found in a series, in the library of the British Museum, demonstrating a jump which sometimes takes place in the rotary gallop of the deer, which system of motion is always used by the deer and also by the dog, when from caprice or necessity they endeavor to make rapid progress. This distinctive method of galloping was unknown, and, indeed, unsuspected by us moderns, until revealed by photographic investigation of animal locomotion; but it was apparently well known to the early artists of Egypt.

UNIVERSITY AND EDUCATIONAL NEWS.

YALE UNIVERSITY has received for the Sheffield Scientific School a new building for mineralogy, geology and physiography. The donor and the value of the building are not announced, but it is to be known as Kirtland Hall, in memory of the late Professor Jared Potter Kirtland. Professor Kirtland, who was a Yale graduate of the class of 1815, and died in 1877, was professor of the theory and practice of medicine in Ohio Medical College and in Western Reserve College. He was a member of the National Academy of Sciences, and served on the geological survey of Ohio. Plans for the new building show a four-story structure of 95 feet front and 65 feet depth. It will be of plain red brick, with white marble and other stone trimmings. Designs were made by Kirtland Kelsey Cutter of Spokane, a great grandson of Professor Kirtland. The main floor will be devoted to mineralogy, the second floor to inorganic and physical geology, the third to physical geography and physiography, and the basement to mining.

A NEW building, chiefly for surgery, is to be erected for the Johns Hopkins Medical School at a cost of $100,000.

Boylston Hall, the chemical laboratory of Harvard University, has been much overcrowded during the last two years. There is about to be added a wing 83 x 33 ft. which will be used by the elementary classes until a new building is constructed.

Mr. Robert S. Brookings and others have presented to Washington University a building which was erected for the use of the St. Louis Club. This building will now be used for the Washington University Club, an organization including professors, male graduates and students of Washington University. The annual dues will be $5.00. The Club will also provide board for students whose homes are not in the city of St. Louis. An effort will be made to bring representatives of all departments of the University together in this club, to afford good board at reasonable prices, and make the club a home for the graduate and undergraduate students of the University.

The late Henry S. Morton, president of the Stevens Institute, has bequeathed his scientific instruments to the institute.

Cushing Academy at Ashburnham, Mass., has received a legacy estimated at from $200,000 to $400,000 by the will of Jacob H. Fairbanks of Fitchburg. The town of Ashburnham receives $40,000 for a memorial town hall.

In the abstract of the accounts recently submitted to Convocation, the total benefactions at Oxford University last year are announced to be £2 13s. 4d., an increase of 8d. over the previous year.

The U. S. Military Academy at West Point will celebrate its centennial next week. The president of the United States will be present, and the leading universities and scientific schools will be represented by their presidents.

Hereafter Latin will not be required as part of the matriculation examination of the University of London. Logic, drawing, advanced mathematics and geography are added to the subjects that may be elected.

Several alterations in the regulations for the Natural Sciences Tripos at Cambridge University have been passed, including the proposal that, in arranging the class list for the second part of the examination, the examiners may place a candidate in the first class for proficiency in one of the following branches of science: chemistry, physics, mineralogy, geology, zoology and comparative anatomy, human anatomy, physiology. This was opposed but carried by two votes, the numbers being—placet 75, non-placet 73. Under the old regulations no candidate was placed in the first class for proficiency in one subject unless he had a competent knowledge of some other subject.

The following degrees were conferred at the University of Colorado on June 5: M.A. 6, M.S. 2, B.A. 3, B.S. 8, B.Ph. 19, B.S. in engineering 8, LL.B. 12, M.D. 13. A new department of mechanical engineering has been added to the engineering school.

Dr. John Dewey, professor of philosophy at the University of Chicago, has been appointed to the office of director of the School of Education, made vacant by the death of Col. Francis W. Parker.

The Rev. Dr. G. P. Denton, president of the Upper Iowa University, has been elected president of Miami University, Oxford, Ohio. The Rev. Norman Plass, of Williamstown, Mass., has been elected president of Washburn College, Topeka, Kansas.

Arthur Byron Coble, fellow in mathematics in the Johns Hopkins University, has been appointed to the chair of mathematics in the University of Missouri.

Dr. Josiah Royce, professor of philosophy at Harvard University, will deliver the commencement address at Iowa College, Grinnell, at which time the new president, Dr. E. F. Bradley, will be installed.

Professor Menschutkin, who holds the chair of chemistry in the University of St. Petersburg, and Professor van Geer, who holds the chair of mathematics in the University of Leiden, have retired from the active duties of their professorships.

Mr. T. B. Wood, of Gonville and Caius College, has been appointed reader in agricultural chemistry at Cambridge University.

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, JUNE 13, 1902.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson. N. Y.

*THE LAWS OF NATURE.**

WE say that nature is unchanging, and so perhaps it is, in the eye of some eternal being, but not in ours, for the things that we see from day to day, appear permanent only by comparison with the duration of our own brief life, and our own little experience.

An inhabitant of the land where nature has just passed through such an awful convulsion, with a loss of life greater for so short a time than history has ever recorded, might have said in the morning that nature never changes, because it had never changed in his own little experience; but he would not have said so at that day's close. Now the experience of the entire human race is far briefer relative to nature's duration than that of one of these islanders who knew the green mountain with its fresh lakes only as a place of quiet rest, up to the moment when the gates of hell were opened under it.

Nature, then, really changes, and would apparently do so if man were not here; for it is not man's varying thoughts about nature that make her change. But there is something quite different which does change because of man, and which apparently would not change if he were not here. This is what he calls the 'laws of nature.'

* A paper read before the Philosophical Society of Washington, May 10, 1902.

The assumption that there are such things is due to him, and such 'laws' are known only through his mind, in which alone nature is seen.

It is perhaps a hard saying to most that there are no such things as 'laws of nature'; but this is the theme on which I have to speak.

These, then, are the laws of man's own mind, or the effects of his own mind, which he projects outside of himself and imagines to be due to some permanent and unalterable cause having an independent existence. This is not only because his season for observation is but a moment in the passage of nature's eternal year, and because with his pathetic sense of his own weakness he would gladly stay himself on the word of some unchanging being. It is because this sense of dependence is strangely joined with such self-conceit that when he listens to what he himself says he calls it the voice of God. From these twin causes, arising both from his inability as a creature of time to observe nature, which is eternal, and again from his own overweening sense of his own capacity to know her, he looks for some immutable being whom he believes to have written his own ideas in what he calls 'the book of nature.'

I am not questioning the existence of such a being as the 'Author of Nature'; but asking if such a volume as is imputed to him, ever really existed. The very phrase, 'book of nature,' is a legacy from moribund mediæval notions of a lawgiver; and it, with the vitality of words which carry to us dying ideas, has lived on to our own time, when we can no longer believe it in our hearts, although it is still upon our lips.

To convince ourselves, we need only pause a moment to ask the simple question whether there is any authority who has prepared such a clearly written book of statutes in which we can really read nature's laws.

The question answers itself.

I repeat that I am not denying here the existence of such a being as the imputed author of these laws, but say that, ignorant as we are of what is being done by him, we cannot read his thoughts in our momentary vision of what is forever passing.

'For my thoughts are not your thoughts, neither are your ways my ways, saith the Lord' is a caution which, whether believers or not, it would not harm us to consider; and when we say that these 'thoughts' are written in 'the book of nature,' this cannot mean that they are legible there as in a statute book where he who runs may read. If nature is to be compared to a book at all, it is to a book in the hands of an infant to whom it conveys little meaning, for such are we; or rather it is like a 'book of celestial hieroglyphs, of which even prophets are happy that they can read here a line and there a line.'

I hope what I am trying to say may not bear the appearance of some metaphysical refinement on common sense. It is common sense that is intended, and the 'laws of nature' that seem to me a metaphysical phrase.

To decorate our own guesses at nature's meaning with the name 'laws of nature' is a presumption due to our own feeble human nature, which we can forgive for demanding something more permanent than itself, but which also leads us to have such an exalted conceit of our own opinions as to hide from ourselves that it is these very opinions which we call nature's laws.

The history of the past shows that once most philosophers, even atheists, thus regarded the 'Laws of Nature,' not as their own interpretations of her, but as something external to themselves, as entities partaking the attributes of Deity—entities which they deified in print with capital letters—as we sometimes do still, though these 'Laws' now are shorn of 'the glories of their birth and state' which they once wore, and are not turning out to be 'substantial things.'

But are there not really things (like the fact of gravitation, for instance) external to ourselves, which would exist whether we were here or not, and which are part of the order of nature? Apparently, yes, but part of the *laws* of nature no!

The phrase even yet exercises a wide influence, though it has seemed to me that a significant change is taking place in the leaders of common opinion with regard to the meaning that the words convey.

I presume that the greater proportion of us here are interested in science. I may indeed assume that we all are; and I want to inquire what lesson for us, as students of nature, there lies in the fact that we are no longer impressed by her 'laws' as were the scientific men of a former generation.

It is convenient to measure the distance we have passed over, by the fact that one hundred and fifty years ago, one of the acutest of reasoners, David Hume, published a still celebrated argument against miracles, which within my own recollection was held to be so formidable that those who were reluctant to believe in his conclusions, were still unable to offer a good refutation. The immense number of attempted refutations and their contradictory character are perhaps the best testimony for this.

Hume defines a miracle as a violation of the 'laws of nature,' and his argument, concisely stated, is that there must 'be a uniform experience against every miraculous event, otherwise the event would not merit that appellation, and as a uniform experience amounts to a proof, there is here a direct and full proof from the nature of the fact against the existence of any miracle.'

Now while his argument is logically as conclusive as ever, it to-day convinces only those who are anxious to accept its conclusion.

What is the reason for this great change?

We may ask what the laws of nature really are, and pass from what they were thought to be by Hume to what they are beginning to be understood to be by us, without here inquiring into the intermediate steps which brought the change about.

It seems to me that the argument which was conclusive not merely to the learned, but to the common cultivated thought of Hume's time has never been expressly refuted when its premises were admitted (and the generation following him admitted them); and yet this compelling argument, as it once seemed, is gradually losing its force to most minds, not through counter argument, but by an insensible change of opinion in the attitude of the thinking part of our public as compared with his, a change about certain fundamental assumptions on which the argument rested, and from his own views of the universe to those we are beginning to take.

In the first place, the immensely greater number of things we know in almost every department of science beyond those which were known one hundred and fifty years ago, has had an effect which doubtless could have been anticipated, but yet which we may not have wholly expected. It is, that the more we know, the more we recognize our ignorance, and the more we have a sense of the mystery of the universe and the limitations of our knowledge.

I believe it may be said that, if not to Hume, at any rate to the majority of those about him, and to his later contemporaries, there was very much less mystery in the world than we see in it, and if it were then still occasionally said that there were 'things in heaven and earth not dreamt of in 'their' philosophy,' these words must have struck on the self-complacent minds of his generation as something to be tolerated as poetic license, rather than as accurate in philosophic meaning. Compared with ours, that whole century was satisfied with itself and its knowledge of the infinite, and content in its happy belief that it knew nearly everything that was really worth knowing. This 'nearly everything' which it thought it knew about the universe, it called the 'laws of nature.'

It was to this belief in the general mind, I think, that the success of Hume's argument was due.

The present generation has begun, if not to be modest or humble, to be somewhat less arrogant in the assumption of its knowledge. We are perhaps beginning to understand, not in a purely poetical sense, but in a very real one, that there may be all around us in heaven and earth, things beyond measure, of which 'philosophy' not only knows nothing, but has not dreamed.

As a consequence of this, there is growing to be an unspoken, rather than clearly formulated, admission that we know little of the order of nature, and nothing at all of the 'laws' of nature.

Now if we are at present at least, disposed to speak of an observed 'order' of nature (not carrying with it the implication of necessity denoted by 'law'), I think we have some reason to say that there is a prescience of a change in common thought about this matter, and that it is owing to this that we are coming to be where we are.

I do not know that there is a less wide belief in the gospel miracles in our day, but if it were so, the decline in the weight given Hume's argument is not due solely to that, for it may surely be said that it was not merely an argument against gospel miracles, but against all the prodigies to be found in history, sacred and profane, where he doubtless had in mind traditions of stones falling out of heaven, cures wrought by psychological agency, and the like, all 'superstitions' to the men of his day. These if they no longer believed in a deity, were none the less shocked by the culpable existence of such vulgar beliefs in conflict with the deified 'laws of nature,' while such 'superstitions' have in our day become subjects of modest inquiry.

Let me quote from a later writer, whose point of view is singularly different from that of Hume and his contemporaries, and who in answer to the question, 'What is a miracle?' begins by reminding us that the reply will depend very much upon the intelligence of the being who answers it, or whom the miracle is wrought for.

"To my *horse,* do I not work a miracle every time I open for him an impassable turnpike?"

"But is not a real miracle simply a violation of the 'laws of nature'? ask several. What are the laws of nature? Is it not the deepest law of nature that she be constant?" cries the illuminated class; "is not the machine of the universe fixed to move by unalterable rules?"

"I believe that nature, that the universe, which no one whom it so pleases can be prevented from calling a machine, does move by the most unalterable rules. And now I make the old inquiry as to what those same unalterable rules, forming the complete statute-book of nature, may possibly be?

"'They stand written in our works of science,' say you; 'in the accumulated records of man's experience.' Was man with his experience present at the creation, then, to see how it all went on? Have any deepest scientific individuals yet dived down to the foundations of the universe, and gauged everything there? Alas, these scientific individuals have been nowhere but where we also are; have seen some handbreadths deeper than we see into the deep that is infinite, without bottom as without shore.''

''Philosophy complains that custom has hoodwinked us from the first; that we do everything by custom, even believe by it; that our very axioms, boast as we may, are oftenest simply such beliefs as we have never heard questioned. Innumerable are the illusions of custom, but of all these perhaps the cleverest is her knack of persuading us that the miraculous, by simple repetition, ceases to be miraculous!''

A lesson for us, as people who are most of us interested in science, showing how little its most fixed conclusions may be worth, may perhaps be conveyed in an example. A century and a half ago, when the new science of chemistry won its first triumphs, the fundamental discovery which was to illuminate the whole science, the settled acquisition which it seemed to have brought to us, the thing which was going to last, was 'phlogiston.'

This had everything to recommend it, in universal acceptance, and in what seemed to the foremost men of the time, its absolute certainty.

''If any opinion,'' says Priestley, ''in all the modern doctrine concerning air be well founded, it is certainly this, that nitrous air is highly charged with phlogiston. If I have completely ascertained anything at all relating to air, it is this.''

I am trying here to say that laws of nature are little else than man's hypotheses about nature.

Phlogiston was then to the science of a former age, in this sense a law of nature, at least as great a generalization as the kinetic theory of gases is to us; as widely accepted, as firmly believed and as certainly known—but what has become of it now?

Can we tell, then, in advance by any criterion what a 'law of nature' is?

With a curious begging of the question some answer, 'Yes, for laws of nature have this distinction, that they have never been disproved.' As if one were to say, Yes, because when they *are* disproved we deny that they are laws of nature!

Those of us who are capable of being instructed or warned by the history of human thought may, then, ask what kind of a guarantee are we to have for any other 'fact' of our new knowledge? May they not—all these 'facts'—be gone like the baseless fabric of this vision, before another hundred years are passed?

The physical sciences seem to have had less change in their theories than the mighty displacements in other branches of natural knowledge, but it is a truism to say that all are changed, and it should be a truism to add that the 'laws of nature' are not to us what they were a hundred years ago.

I repeat that of the 'order' of nature we may possibly know a little; but what are these 'laws' of nature? What celestial act of congress fixed them? In what statute book do we read them? What guarantees them? Our mistake is in believing that there is any such thing, apart from our own fallible judgment, for the thing which the 'laws of nature' most absolutely forbid one generation to believe, if it only actually happens, is accepted as a part of them by the succeeding.

Suppose that a century ago, in the year 1802, certain French Academicians, believing like every one else then in the 'laws of nature,' were invited, in the light of the best scientific knowledge of the day, to name the most grotesque and outrageous violation of them which the human mind could conceive. I may suppose them to reply, 'if a cartload of black stones were to tumble out of the blue sky above us, before our eyes, in this very France, we should call *that* a violation of the laws of nature, indeed!' Yet the next year, not one, but many, cartloads of black stones did tumble out of the blue sky, not in some far off land, but in France itself.

It is of interest to ask what became of the 'laws of nature' after such a terrible blow. The 'laws of nature' were adjusted, and after being enlarged by a little patching, so as to take in the new fact, were found to be just as good as ever! So it is always; when the miracle *has* happened, then and only then it becomes most clear that it was no miracle at all, and that no 'law of nature' has been broken.

Applying the parable to ourselves then, how shall we deal with new 'facts' which are on trial, things perhaps not wholly demonstrated, yet partly plausible? During the very last generation hypnotism was such a violation of natural law. Now it is a part of it. What shall we say, again, about telepathy, which seemed so absurd to most of us a dozen years ago? I do not say there is such a thing now, but I would like to take the occasion to express my feeling that Sir William Crookes, as president of the British Association, took the right, as he took the courageous, course in speaking of it in the terms he did. I might cite other things, the objects of ridicule only a few years ago, of debate now, but which have not all found supporters who possess the courage of their convictions.

The lesson for us in dealing with them is not that we should refuse to believe, on the one hand, and sneer at everything which is on its trial; for this, though a very general and safe procedure, is not the one to be recommended to those of us who have some higher ideal than acquiescence with the current belief.

The lesson for us is that we must not consider that anything is absolutely settled or true.

This is not to say that we are to be blown about by every wind of scientific doctrine. It is to be understood as a practical rule of life, that we must act with the majority where our faith does not compel us to do otherwise; but it seems to me that we must always keep ready for use somewhere; in the background of our mind possibly, but somewhere, the perhaps trite notion that we know nothing absolutely or in its essence; and remember that though trite it is always true, and to be kept as a guide at every turning of the scientific road, when we cannot tell what is coming next.

How many doctrines of our own day will stand the light of the next century? What will they be saying of our doctrine of evolution *then?* I do not know; but let me repeat what I have said elsewhere, that the truths of the scientific church are not dogmas, but something put forward as provisional only, and which her most faithful children are welcome to disprove if they can. I believe that science as a whole is advancing with hitherto unknown rapidity, but that the evidence of this advance is not in reasoning, but in the observation that our doctrine is proving itself, by the fact that through its aid nature obeys us more and more, as I certainly believe it does.

Never let us forget, however, that man, being the servant and interpreter of nature, as Bacon says, can do and understand so much, and so much only, as he has *observed* of the course of nature, and that beyond this he neither knows anything nor can do anything. No walk along 'the high priori road' will take him where he wants to go, and no 'law of nature' will certainly help him.

But these 'laws,' having authority only as far as they are settled by evidence, and by observation alone, it may be a just inquiry as to what constitutes observation, and above all, who judges the evidence. If the kinetic theory of gases, for instance, is a matter of inference rather than of observation, are we sure that we have a better guarantee for it than a previous century had for phlogiston? Our good opinion of ourselves, as compared with our scientific fathers, makes us think we have. I think myself that we have; and yet, remember, it is the same human nature which judged that evidence then, that judges this evidence now, and remember that however rapidly science changes human nature remains very much the same, and always has a good conceit of itself.

While we are venturing to utter truisms, I repeat, let us take once more this one, home to ourselves, that there is a great deal of this 'human nature' even in the best type of the scientific man, and that we of this twentieth century share it with our predecessors, on whom we look pityingly, as our successors will look on us.

Let us repeat, and repeat once more, that though nature be external to ourselves, the so-called 'laws of nature' are from within —laws of our own minds—and a simple product of our human nature. Let us agree that the scientific imagination can suggest questions to put to nature, but not her answers. Let us read Bacon again, and agree with him that we understand only what we have observed. Finally let us add that we never understand even that, in the fullness of its meaning, for remember that of all the so-called laws of nature the most constantly observed and most intimately and personally known to us, are those of life and death—and how much do we know about the meaning of *them?*

S. P. LANGLEY.

SMITHSONIAN INSTITUTION.

KINETIC EVOLUTION IN MAN.

IN a recent number of SCIENCE Mr. W J McGee has summarized his reasons for holding that anthropological evolution is a process of integration standing in direct contrast to the divergence of biological evolution:

"The great fact attested by all observation on human development, and susceptible of verification in every province and people, is that mankind is not differentiating in either physical or psychical aspects, but are converging, integrating, blending, unifying, both as organisms and as superorganic groups.

"Everywhere the developmental lines converge forward and diverge backward, just as the lines of biotic development diverge forward and converge backward. How this discrepancy is to be removed is a question whose importance increases with every advance in the science of anthropology."*

That human evolution is synthetic appears undeniable, but the discrepancy pointed out by Mr. McGee has been removed in advance by the recognition of the same leading principle in biological evolution. Man is better known than any other animal, and evolutionary theories which do not accommodate this best certified series of biological facts might well have been distrusted. The kinetic factor of synthesis has been neglected because biologists as well as anthropologists have failed to perceive that evolutionary progress is a cause instead of a result of the differentiation of species or varieties, but since evolution must be studied in species an adequate comprehension of the evolutionary phenomena of any specific group should make plain their relation to more general principles.

Isolation and segregation favor constancy in the characters by which systematists are accustomed to distinguish species, but it is as erroneous with other animals as with man to infer from this that isolation conduces to evolutionary

* 'Current Questions in Anthropology,' SCIENCE, N. S., Vol. 14, No. 365, pp. 996 and 997.

progress. The truth lies rather with the contrary proposition, since the unknown causes of variation also predispose to the perpetuation, communication and accumulation of organic, physiologic and other tendencies of change. Some variations or mutations are of little evolutionary significance and must be segregated in order to be preserved, but others are notably prepotent and are accepted by a large proportion of the individuals of successive generations. Reproductive accessibility to prepotent variations is the measure of evolutionary progress. Species confined to small areas are often distinct from each other by characters of no diagnostic significance among related forms of wide distribution. The latter appear plastic and flexible because they have access to many avenues of biological motion, while the former maintain a relatively narrow and stable uniformity because the few genetic variations are soon distributed through the small number of individuals.

Evolution may be termed a kinetic* process because change is not only a potential but an essential of organic existence. Static theories have sought to explain organic changes as the results of external influences; dynamic theories imply the organic predetermination of such changes; only under a kinetic theory may we admit that the changes of biological evolution have not been caused by external conditions nor by internal mechanisms, but are the manifestations of a form of motion the nature and efficient causes of which are even farther beyond the present range of our comprehension than those of the motions which underlie the phenomena of physics and chemistry.

However striking their results in particular instances, natural and other forms of selection represent the incidents rather than the causes of evolution, and instead of being called forth and carried forward only by external forces, the gradual accentuation of characters of no direct importance or utility commonly accompanies increasing organic efficiency. Thus it has been found that varietal divergences from the specific mean of the human skull are correlated with increased intellectual power, as represented by greater cerebral bulk.

"In a brachycephalic race the rounder the skull the greater the capacity, in a dolichocephalic race the narrower the skull the greater the capacity—the greater capacity following the emphasis of the racial character."*

Equally indifferent functionally and selectively are most of the characters of skin, hair, bones and other physical features used by anthropologists in classifying mankind, and in speculating upon the origins of the various ethnic groups. Closely analogous differences are found everywhere among the species and varieties of mammals, and they require no special explanation unless it be to place them among the many indications that the varieties of primitive man had fewer facilities of transportation and more definite geographical localization than their modern representatives. Had such segregation become complete all the requirements for the differentiation of species would have been met, and modern zoologists could make no serious or consistent objection to the treatment of the Tasmanians, Australians, Andamanese, Papuans, Ainus† and similarly isolated groups as species, no matter how insignificant a fraction of

* 'A Kinetic Theory of Evolution,' Science, N. S., Vol. 13, June 21, 1901, p. 969.

* Alice Lee in Science, N. S., Vol. 12, No. 312, p. 948.

† I am indebted to Dr. Leonhard Stejneger for the suggestion of racial affinity between the Papuans and Ainus. Dr. Stejneger holds also that the domestic and social economy of the Ainus indicates tropical origin.

the genus *Homo* they may include. On the other hand it seems preferable to admit that these islanders are but outliers of the larger curl-haired specific complex which covered the Old World before the arrival of the coarse-haired, smooth-skinned American species of mankind. On the continents strictly isolated groups have seldom existed for long periods, although the separation of remote peoples has been sufficient to permit the accumulation of diverse habits and characteristics which in less active, intelligent and resourceful animals would have resulted in disintegration into many segregated species.

A kinetic theory of evolution permits us to recognize the fact that with man, as in other lines of descent, there have been both differentiation and integration, and these not at separate times, but simultaneously and universally.* Moreover, we gain a standpoint from which many formal propositions like monogenesis and polygenesis appear unnecessary for the exposition of evolutionary facts. From the standpoint of biological evolution it is about equally improbable that any given species has descended from one or two parents as that it has been compounded from distinct lines of descent. Mr. Keane, who is cited by Mr. McGee as a polygenist, is fond of discussing what he calls 'precursors' but he apparently holds still to the traditional supposition that different races originated in Central Asia and subsequently spread themselves to the various quarters of the globe, a proposition obviously contrary to all pertinent analogies of general biology. We are not told why one neighborhood should have given rise to so much diversity, nor why the newly formed races did not fuse at once into one homogeneous complex and thus save the ethnologists much speculation.

Few discussions of the evolution of man are without one or more of the following assumptions:

1. That man originated at some particular locality.

2. That he became differentiated into three or more distinct races or varieties.

3. The commingling of these formed the numerous peoples of the earth whose origins and pedigrees are to be inferred by resolving their characteristics into those of the component racial types, much as the artist analyzes his colors or the chemist his compounds.

Monogenists and polygenists are about equally partial to these unproved and improbable opinions, and as their differences are matters of formal terms and definitions the opportunities for scholastic controversy are excellent. At some sufficiently remote time there was a species of limited distribution which included the direct progenitor of man, but was this interesting creature man or ape? And did it differentiate into races of men or merely into varieties of apes or 'precursors' which became human independently and then hybridized to form the complex now called man? These questions can be debated indefinitely by the well-known expedient of varying the definitions which shall determine when the animals became men in the modern sense and were no longer 'old time people,' as the natives of Liberia call the chimpanzees.

But since no other animal or plant has the wide distribution of man, we may well suppose that this was attained after he had far surpassed all related species in intelligence and resourcefulness, and further

* That divergence as well as convergence has occurred even in the historic period is well shown by such examples as the colonists of Virginia and Massachusetts who though they had formed part of the same community in England developed on independent lines in America until they were reincorporated into another social and political organization. The South African Boers might also be compared with the Dutch colonists of New York.

that the same qualities and tendencies which gave him this extensive range have prevented complete isolation, except in the presence of physical barriers. Polygenesis ascribes these unique powers to several apes in spite of the fact that with the exception of man, all existing species of the order Primates are animals of very limited distribution.

The doctrine of polygenesis marks a natural reaction from that of a too narrow monogenesis, but in its extreme extension attains an equal absurdity. Moreover, the term itself is unfortunate in implying many distinct centers or lines of descent which would but multiply the difficulties. The logical and biologically defensible antithesis of monogenesis is not polygenesis but eurygenesis, or the predication of a wide and largely decentralized distribution of primitive man or his precursors, if the term be preferred. Strictly speaking, man might be monogenetic and still originate all over the world by the gradual amelioration of a cosmopolitan species; and polygenesis by requiring two or more separate derivations or ameliorations, is on the biological plane an assumption inconsistent with that of an evolution by convergence and integration which would be retarded rather that advanced by the implied isolation.

Exponents of both monogenesis and polygenesis apparently neglect also the obvious fact that man's origin and primary distribution are zoological rather than ethnological questions, since an indefinitely great period of time must have elapsed between the organic perfection of man and the development of the races, languages, customs and arts studied by anthropologists. But even on zoological and geological grounds the question of origin is still in the balance, and as competent an anthropologist as Sir William Flower frankly admits that 'it is quite as likely that the people of Asia may have been derived from America as the reverse.'*

Not even the fact that all of man's quadrumanous relatives were confined to the Old World is conclusive. Indeed, it is strange that under static theories of evolution it was not argued that man must have originated in America, on the ground that he would not have attained his human characteristics while exposed to intermixture with his more backward simian relatives. And in further support of such a view it might have been observed that the curled hair which characterizes the peoples deemed most primitive in the Old World is apparently a specialization, the higher apes having straight hair. Likewise the small cerebral bulk of even the most advanced of the aborigines of America does not indicate descent from larger brained Old World stock.

In accordance with the evidence of tradition, history and general biology we may ascribe the convergence and integration of customs, languages and races to the intercommunication which is at once a cause and a result of human progress toward civilization. No one race or nation has had a monopoly of improvement and discovery and those which continue to progress generally obtain more from others than they originate themselves. Specialization and isolation which resist change are as clearly misfortunes to nations as to plants and animals. Within historic times the physical and intellectual powers of the race are not known to have increased, but the synthesis of skill and knowledge has continued with accelerated rapidity. Modern nations pride themselves on their adaptability, and no longer emulate the changelessness of the Medes and Persians and the Chinese.

That the nations of the earth are of one blood does not mean that they were ever of

* *Journn. Anthrop. Inst. Gt. Britain,* 14: 391. London, 1885.

one language or one system of customs and arts, in the origination of which the doctrine of polygenesis has a wide application, since history and daily experience show that new linguistic, industrial and artistic elements originate in definite places and often with single individuals. The use of tools and weapons gave man the advantage over his fellow-creatures, and progress has been mirrored in the diversification and improvement of these servants ever since the time when all men used the unspecialized celt which the reminiscent native of Liberia still holds in his hand in leisure moments to give him that most enjoyable sensation of weight and importance. Modifications and inventions are constantly being made; use is necessarily local and hence divergent at first, but with modern facilities of communication may extend in a few years through regions which formerly would not have been penetrated in as many generations.

Civilization itself is at once a test and a testimony of the attraction exerted by new characters, powers and specializations, and of the momentum with which the motion due to such attractions may increase. Primitive and conservative are ethnological synonyms, and with races, as with individuals, it is ever the strongest and the most intelligent which are susceptible to the new idea or invention. The constant succession of modes and fashions is perhaps the most obvious example of the inherent human tendency to the new, and motion on this line is also conspicuously more rapid in our complex and utilitarian civilization than among primitive peoples. Human progress has not advanced by a uniform rate of motion; the facts of ethnology and history indicate the probability that it took more centuries to introduce the use of fire than it has required years to popularize electricity.

Somewhere intermediate between the zoological monogenesis of man's body and the ethnologic polygenesis of nations, languages and arts, there was what may be termed a biologic coordination of man and his supporting environment which placed him definitely upon the line of social and industrial progress. As long as man was content to rely upon natural products his existence was precarious and left no traces in organic nature, but in passing from the feral to the domestic state he interfered in the evolution of other species and thus gave biological clues for the location of this focus of anthropological interest. The cultivated plants were in use long before the integrations which formed present peoples, languages and arts, and thus afford far more weighty testimony on racial origins and affinities.

The Egyptian and Chaldæan civilizations mark the eastern horizon of human history, but from the evolutionary standpoint they appear separated from us by but a narrow foreground. Our belief in their primal antiquity is but a reflection of traditions chronologically ancient, though biologically recent, and affording no valid opposition to the evidence that the oldest domestic plants were not natives of the Old World, but of the New, where the scarcity of nourishing fruits encouraged the use and simple cultivation of starch-producing roots, which before the domestication of cereals became the basis of a permanent food-supply and of social, industrial and cultural progress, impossible among wandering hunters and shepherds.

It has seemed reasonable to seek the origin of civilization among the most capable peoples, but, on the other hand, it should be remembered that great natural abilities have not produced civilizations except under favorable conditions. In Roman times the Teutonic peoples had not advanced much beyond the economic status of savages, and yet with brief opportunity they were able to adopt and even to improve upon the ancient cultures of the Mediterranean countries. Civilization is not an inherent but merely a potential character, more easily lost than gained, and in its earlier stages readily influenced by facts and conditions as truly biological as those which have conduced to the upbuilding of the even more specialized organization of the social ants and termites.

On this ground we may also disregard the opinion general among ethnologists and historians that the pastoral stage with which the civilization of the Mediterranean region was supposed to have begun was merged gradually and spontaneously into the agricultural. Primitive pastoral tribes are everywhere more or less nomadic, and pastoral prosperity does not conduce to a more settled existence, but makes necessary a wider range of feeding grounds, so that we should need to imagine the semi-savage shepherd planting and fencing plots of millet, barley or beans with the intention of experimenting upon new vegetable foods. But such an idea is so absurdly inconsistent with the instinctive conservatism of man's food habits that we can but believe that the pastoral natives of the Mediterranean region built civilizations only when brought into synthesis with other peoples who had made independent progress on agricultural lines.

Predatory, nomadic and pastoral peoples may develop excellent physical and mental powers, but the primary condition for the genesis of civilization is the settled social organization of an agricultural community. That agricultural habits of life conduce to civilization even among relatively inferior tribes is well shown in the numerous centers of ancient primitive culture developed in the tropics of the American continent. Ethnologists have decided that all this diversity of incipient civilizations was truly indigenous and not imported, as formerly suspected on the ground of many racial and cultural resemblances with the peoples of eastern Asia. This opinion is further supported by the biological fact that of the many plants cultivated in ancient America only the banana appears to be exotic, and this probably arrived not many centuries before the coming of Europeans.

The American origin of agricultural man in no way conflicts with an Old World origin for zoological and geological man, though these questions are often confused by ethnological writers. Such cultural tendencies as may have existed in the Mediterranean region before the arrival of agricultural influences from America appear to have been confined to the domestication of animals as the basis of a diet largely carnivorous. The aborigines of the island of Palma in the Canary group had four domestic animals and no domestic plants. The predication of independent agricultural beginnings in the Old World is rendered unnecessary by two facts long well known though strangely neglected; first, that the tropics of the Old World from Hawaii and Easter Island to Madagascar and Sierra Leone were overrun by a single primitive, agricultural, seafaring race; and, second, that this race was in possession of numerous cultivated plants of American origin. To infer from these facts that the Polynesians, Malays or Chinese came from America would be to ignore the probability that the trans-Pacific migration of this primitive culture race took place long anterior to the formation of existing peoples and languages. The identity of the tropical cultivated plants, several of which are propagated only by cuttings, renders gratuitous all objections on the score of distances and difficulties of communication, and the racial and cultural similarities of the peoples of the two shores of the Pacific render their community of origin antecedently probable. Ethnologists have demonstrated the indigenous character of American man, but the coarse-haired yellow and brown races of Asia are evidently intruders who have replaced or amalgamated with older curl-haired peoples. While it is not impossible that some elements of the Mongoloid series may have entered Asia from the northeast, the tropical plants could scarcely have been taken over by way of Alaska, and megalithic ruins and other traces of primitive cultures similar to those of ancient America mark a route from Easter Island to Fiji, Sumatra, Madagascar and southern Arabia, whither archeologists now trace the straight-haired men who initiated the agricultural civilizations of the valleys of the Nile and Euphrates.

With the assistance of a kinetic theory of evolution and of pertinent facts and analogies it is thus possible to sketch anthropological evolution without the predication of conditions essentially different from those which exist at the present day. Man is a relatively ancient animal which long since attained a cosmopolitan distribution. Divergent tendencies of variation met, however, with ever-strengthening opposition through the growth of mental powers and social habits, and the segregation of groups comparable to zoological species took place only through geographical isolation. The specific separation of the peoples of the two continents also came to an end with the development in America of the arts of agriculture, navigation and government, which resulted in the conquest and colonization of the islands and shores of the Pacific and Indian Oceans, and the subsequent integration of the superior mixed races and civilizations of these and the adjacent regions.

O. F. COOK.

WASHINGTON, D. C.

THE NEW LABORATORY AND GREENHOUSE FOR PLANT PHYSIOLOGY AT SMITH COLLEGE.

THE remarkable renascence which botany is experiencing in America, both in investigation and in education, is intimately associated with the development of plant physiology. The reason is plain. The present movement is essentially an exploitation of the new field opened up by our new view of the plant as not primarily a living structure, but a living being. Hence the study of all vital processes becomes of first importance. The new physiological equipment of Smith College, here to be described, is an adaptation to the ever-increasing importance of plant physiology.

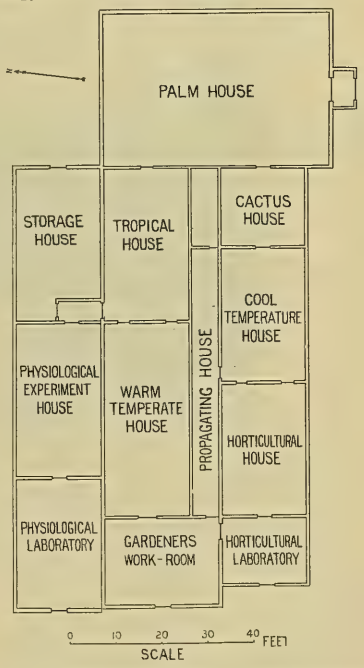

FIG. 1. Ground-Plan of the Lyman Plant House at Smith College.

Smith College has possessed for four years, as an adjunct of the Department of Botany, a thoroughly built, properly stocked and fully manned range of greenhouses, known as the Lyman Plant House, of which the ground-plan is illustrated herewith (Fig. 1). The new laboratory and greenhouse, now completed, have been attached to the range as shown in this plan. The storage house is at present used as a cool house for plants not in growth, but it is so built that, if the expansion of the college work requires, it can be added to the experiment house by the simple removal of a partition.

The appearance of the laboratory in relation to the greenhouses is shown in Fig. 2. The laboratory appears in the center of the picture; to the right is seen the gardener's work room, and beyond that a portion of the horticultural laboratory, while the greenhouses extend in parallel rows behind these buildings. The laboratory is plainly but thoroughly built of brick, of 20 x 28 feet in area, and is designed to afford ample, but not unnecessary, room for twelve students. The interior arrangements are well shown by Figs. 3 and 4. There are three sorts of tables. The study tables, at which each student has a place with a drawer for personal effects, are of the plain laboratory sort. The apparatus tables, for the assembling of the appliances for experiments, are made three feet in height for convenience of working standing, and beneath them the space is utilized for cupboards in which bell-jars and the larger glassware are stored. The gas and tool table, in front of a window (on the left of Fig. 3), also three feet in height, is fully equipped with the appliances suggested by its name. There are three sets of cases. One is for balances, shown on the left of Fig. 4, with three compartments, and glass doors (shown open in the picture). This is affixed to the brick wall disconnected from the floor, and its top is utilized for the storage of large articles. The second is for chemicals, shown on the right in Fig. 4 (also with glass doors open), with cupboards beneath. The third consists of three cases for the storage of the more elaborate appliances, of which the equipment is excellent; they are partially shown with closed doors on the left of Fig. 3. Beneath them are many drawers, for

Fig. 2. General View of the Lyman Plant House, with the New Laboratory in the foreground.

the storage of the numerous articles necessary in a course in which every student works through a comprehensive series of

FIG. 3. View in the Laboratory, from the door of the Greenhouse.

physiological experiments. And the other furniture proper to such a laboratory, including a blackboard ruled in squares for

FIG. 4. View in the Laboratory, looking toward the Greenhouse.

the plotting of statistical data, is of course present.

More important, however, is the greenhouse, which is illustrated by Figs. 5 and 6. It is 20 x 32 feet in area, very thoroughly built, with ample and readily controlled heating and ventilation systems. The heating pipes are placed against the walls, where they are not in the way. The floor is of cement, of course laid directly upon the ground. The shading is effected by screens of white cloth, resting upon wires; they are very readily drawn up for use or down completely out of the way.

Against the wall of the laboratory (Fig. 6) is a long porcelain-lined sink, with five taps, to which are attachable the tubes leading to a still, an exhaust (with manometer), and a blast, while the necessary funnels, graduates, etc., are arranged above and the pneumatic troughs, basins and the like, beneath it.

Of especial importance in such a greenhouse are, however, two things, the tables and the physiological dark room. There are sixteen tables. Each top is of a single thick, smooth slate, four feet by two, resting at the four corners upon adjusting screws by which they may be set level. The stand, especially designed for the purpose, is of cast iron, of such a pattern as to give the greatest possible rigidity, and of such a height as to bring the top of the table three feet from the floor, a height which experience has shown to be the best for the average student when working standing. They are proving perfectly satisfactory in use. The central table of the greenhouse is covered by a white wooden shelter, lightly built, under which are kept the autographic meteorological instruments, thermograph, hygrograph, etc., indispensable in such a laboratory. Finally we consider the physiological dark room, perhaps the most essential part of the furnishing of a laboratory of plant physiology. It is built of one thickness of brick against the wall of the laboratory (on the right in Fig. 6), but otherwise has an air space all around it whereby it is kept approximately at the average temperature of the greenhouse. It is nearly six by six feet in area, and from six to eight feet high inside. The ventilation is provided for by an arrangement of double-walled black boxes over openings left in the brickwork near the floor, and by a triple roof with communicating air spaces. The details cannot readily be briefly described, but the result is a perfect system of ventilation without the admission of the slightest ray of light. The door has an inner porchway with a second door, both made light-tight by rubber strips, so that by closing one door before opening the other, it is possible to enter or leave the room without the admission of any light. It is provided with shelves, and is entirely painted a dull black inside.

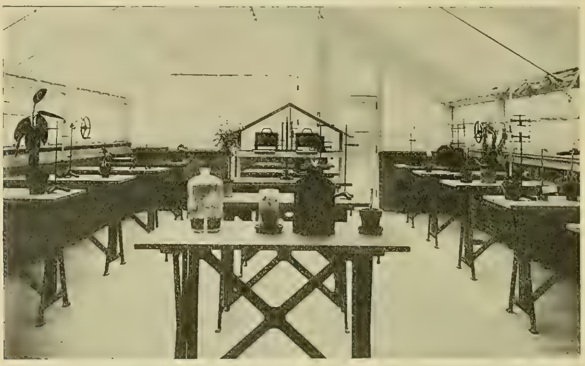

Fig. 5. View in the Greenhouse, from the door of the Laboratory.

A point of much interest about this entire equipment is that it is not intended for investigation (other than pedagogical), but for the instruction of undergraduate students. This is in accord with the policy of the trustees of Smith College, which aims not to develop university work, but to concentrate all effort upon the undergraduate course. This course in plant physiology is taken each year by twelve students, seniors who must previously have had at least two years of botanical study; they work through the course described in the present writer's book, 'A Laboratory Course in Plant Physiology.'

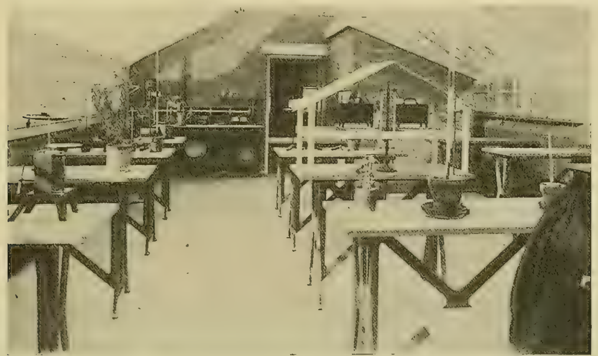

FIG. 6. View in the Greenhouse, looking toward the Laboratory.

The Lyman Plant House was a gift to Smith College from the late Mr. E. H. R. Lyman, of Northampton and Brooklyn, N. Y., in memory of his mother. The new addition to this most appropriate and serviceable memorial is the gift of Mr. Lyman's son, Mr. Frank Lyman, and his daughter, Mrs. Alfred T. White, and her husband. The details of construction have received the close personal attention and the very generous interest of Mr. W. A. Burnham, of the firm of Lord and Burnham, of New York, by whom the additions, as well as the original range, have been constructed. As now finished, the enlarged plant house provides the college with the most essential part of a material botanical equipment of unsurpassed completeness and excellence.

W. F. GANONG.

AN ELECTRIC LAMP FOR MICROSCOPE ILLUMINATION.

THE chief desiderata for a microscope lamp are brilliancy and whiteness of light and an evenly illuminated surface of considerable extent from which to take the light. In planning eight years ago for the illumination of our biological laboratory at the Woman's College of Baltimore, we took into consideration Welsbach lamps and incandescent electric lamps, deciding on the latter. The ordinary incandescent bulb is too small to serve unmodified as the source of light for microscope illumination, and its light is too yellow. These difficulties, however, we have overcome with a fair degree of success by the adoption of two simple devices. Nearly white light is obtained by using forty-volt lamps on our fifty-volt current. This gives much more perfect incandescence than is obtained with a lamp adapted for the voltage used, and, though the lamps burn out more quickly, still they last for a considerable time. Of the eighteen bulbs in use in our laboratory we have to renew about four a year, say twenty-five per cent. annually. We make use of the lamps only during the latter part of the afternoon in winter when the days are short. Little use is made of them at night. A forty-five-volt lamp on a fifty-volt current wears much longer than a forty-volt lamp, and gives a light much less yellow than that from a lamp adapted for the voltage used. For ordinary use such an arrangement is satisfactory.

minated, and the two ground-glass surfaces through which the light passes gives it a very soft effect.

The light thus obtained is not perfectly white, but it is white enough to prove satisfactory in all the use we have given it, and it is very brilliant. We frequently use it in preference to daylight in the demonstration of minute structures, for example in the study of mitosis.

The essential features of this plan of illumination are the diffusion of the light as explained and having bulbs adapted for a voltage from five to ten volts less than that of the current in use.

BIOLOGICAL LABORATORY.

An evenly illuminated surface of considerable extent is obtained in the following way: First a ground glass bulb is used which softens the light; then this is mounted in an ordinary reading globe with mirror back and ground glass front (cf. figure). The mirror-backed globes are much preferable to those with painted backs. The soft light from the ground-glass bulb is so reflected from the mirror at the back of the globe that the whole ground-glass front of the globe is nearly uniformly illu-

These lamps may be mounted in many different ways. We use horizontal stationary lamps between each two desks around the outside of our laboratory; and in the middle of each of the central tables which are used by four students apiece, we have a stationary bracket in which the lamp may be raised or lowered, the lamp fastening by a thumb screw. Professor Drew, of the University of Maine, tells me that he has adopted the same style of lamp in his laboratory, but that he has them mounted on flexible arms which allow the lamp to be placed in any desired position. This seems to me preferable to either mounting we are using.

MAYNARD M. METCALF.
THE WOMAN'S COLLEGE OF BALTIMORE.

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*WORK OF THE AGRICULTURAL EXPERIMENT STATIONS.**

THE agricultural experiment stations in the different States and Territories, as well as the colleges with which they are connected, have been unusually prosperous during the past year. Two things have especially contributed to the greater expansion and increasing efficiency of their investigations. These are their closer affiliation with this Department and the material enlargement of the resources of the agricultural colleges, by means of which the stations have directly or indirectly been benefited.

COOPERATION BETWEEN THE STATIONS AND THE DEPARTMENT.

Much progress has been made in determining the lines in which the stations can most effectively cooperate with the Department, and the methods of arranging and conducting cooperative operations. Since both the stations and the Department have had enlarged resources, it has been possible not only to increase the number of cooperative enterprises, but also to conduct them on a larger scale. In some cases it has been found desirable to form groups of stations to investigate some problem affecting a large region. Thus, for example, a group of stations, in cooperation with the Bureau of Plant Industry, are engaged in investigations on the breeding of varieties of cereals adapted to the Northwest. In other cases a single station is sufficiently aided by the Department to enable it to undertake the thorough treatment of problems in a special line. Thus the Pennsylvania Station, in cooperation with the Bureau of Animal Industry, is preparing to make elaborate researches in animal nutrition, and for this purpose has devised and built a respiration calorimeter for experiments with large animals, which in size and complexity surpasses any apparatus hitherto used for such experiments. In other cases, two or more branches of the Department combine to work in conjunction with a station on some complex problem. Plans are now being made, for example, for an extensive experiment on the problems of range conservation and improvement, in which the Arizona Station will unite with the Bureaus of Forestry and Plant Industry and the Office of Experiment Stations (irrigation investigations). It is evident that a very great variety of effective combinations can be made with the general result of a union of forces thoroughly acquainted with local conditions with those having broad views and relations. Such a strong combination of forces for attacking the problems of agriculture exists nowhere else. It is believed, therefore, that largely increased benefits will soon accrue to our agriculture from this union of the stations with the Department. At the same time the stations were never so strong locally, and are better equipped than ever before to work by themselves on problems of immediate importance to their own constituencies.

The records of this Office show that the Department is at present cooperating with the stations in 43 States and Territories. Among the subjects on which cooperative investigations are being conducted are the following: Tests of varieties of grasses and forage plants in many localities; special experiments with grasses and forage plants for the arid region and the improvement of range lands; breeding ex-

* Part of the Annual Report of the Director of the Office of Experiment Stations.

periments with plants, especially cereals; experiments with hybrid orange trees; the culture of sugar beets, dates and tobacco; planting forest trees; the nutrition of farm animals and man; the gluten content of wheat; plants poisonous to stock; soil investigations; injurious insects, especially the codling moth and locust, and irrigation investigation.

THE OFFICE OF EXPERIMENT STATIONS.

During the past year the work of the Office of Experiment Stations has continued to increase by the addition of new enterprises and the further development of those previously undertaken. Agricultural experiment stations under the direct management of this Office have been established in Hawaii and Porto Rico, and in Alaska the station work has been extended to include experiments in the Yukon Valley. Both the nutrition and irrigation investigations have been conducted on a larger scale than in previous years. The amount of material prepared for publication during the year has exceeded that for any similar period since the establishment of the Office. Unusual opportunities have been afforded for the study of the more general problems relating to the organization and development of agricultural education and research, and there is good reason for believing that along the lines already laid the Office may be able in the future to extend its usefulness in promoting these important interests.

ALASKA EXPERIMENT STATIONS.

The experiment stations at Sitka and Kenai have been continued and a station has been established at Rampart in the Yukon Valley. The chief new feature of the investigations in Alaska during the past year has been the more thorough study of the agricultural possibilities of the interior, especially of the Yukon Valley and the Copper River region. For this purpose Professor Georgeson made journeys through the Yukon Valley in the summers of 1900 and 1901, and Mr. Isaac Jones, who has been the assistant at Rampart, traversed the Copper River region in the summer of 1901. Through these journeys definite information has been obtained regarding the attempts at agricultural operations already made in the regions traversed and the possibilities for the extension of such operations. It was shown that considerable quantities of hardy vegetables, such as potatoes, cabbage, cauliflower, turnips, lettuce and radishes are already being grown in the interior and there are large areas which may be used for this purpose and also for the production of grasses and forage plants. At the station at Rampart rye and barley were matured. At Sitka the experiments with cereals, forage crops and vegetables were continued and a considerable number of varieties were successfully grown. Good silage was also made of native grasses stored in a log silo.

At Kenai the experiments with cereals and vegetables were continued with considerable success. Seeds were distributed to 400 persons living in different parts of Alaska and a considerable number of reports were received of those grown during the season of 1900. It is evident that the efforts of the Government to aid in the development of agriculture in Alaska are greatly appreciated by residents of that Territory, and that they have already received substantial benefits from the work of the Alaska Experiment Stations. The assistant director of this Office, Dr. E. W. Allen, made a tour of inspection to the stations at Sitka and Kenai and reported favorably on their work.

HAWAII EXPERIMENT STATION.

The first appropriation for the establishment and maintenance of an agricultural experiment station in Hawaii was for the fiscal year covered by this report. A preliminary investigation of the agricultural conditions existing in Hawaii with reference to the establishment of an experiment station was made by Dr. W. C. Stubbs, director of the Louisiana Agricultural Experiment Stations, acting under the direction of this Office. On the basis of his report a station was established with headquarters at Honolulu, and put in charge of Mr. Jared G. Smith. The station was located on the tract of land in Honolulu known as Kewalo-uka, which was assigned to this Department by the Government of the Territory of Hawaii. About fifty acres of this tract have been cleared and several small buildings have been erected. The investigations have thus far been confined to studies of a fungous disease which seriously affects taro, and studies of the diseases of poultry. Plans are being made for experiments in horticulture, including both fruits and vegetables, and coffee culture. Cooperative investigations in irrigation will also be undertaken.

PORTO RICO EXPERIMENT STATION.

The first appropriation ($5,000) for agricultural investigations in Porto Rico was made for the fiscal year ended June 30, 1901, and was used for making a preliminary investigation of the agricultural conditions existing in that island, with special reference to the establishment of an experiment station there. This investigation was in charge of Professor S. A. Knapp, formerly of the Iowa Agricultural College, and on the basis of his report Congress made a second appropriation ($12,000) for the current fiscal year, which authorized the Secretary of Agriculture to establish and maintain an agricultural experiment station in Porto Rico.

In the spring of 1901 the investigations in Porto Rico were put in charge of Mr. Frank D. Gardner, who has since made his headquarters at San Juan. The work thus far has been largely confined to an agricultural survey of the island with reference to the best locations for experimental investigations. Experiments in coffee culture and with other crops have, however, recently been undertaken on leased land at Rio Piedras. Studies of injurious insects and plant diseases have also been begun. Improved varieties of seeds and plants have been distributed.

STATISTICS OF THE STATIONS.

Agricultural experiment stations are now in operation under the act of Congress of March 2, 1887, in all the States and Territories, and, Alaska, Hawaii and Porto Rico. In Connecticut, New Jersey, New York, Hawaii, Missouri, Alabama and Louisiana separate stations are maintained wholly or in part by State funds. A number of substations are also maintained in different States. Excluding the substations, the total number of stations in the United States is 60. Of these, 54 receive appropriations provided for by act of Congress.

The total income of the stations during 1901 was $1,231,881.55, of which $720,000.-00 was received from the National Government, the remainder, $511,881.55, coming from the following sources: State governments, $303,892.61; individuals and communities, $1,580.59; fees for analyses of fertilizers, $82,322.40; sales of farm products, $93,363.98; miscellaneous, $30,721.-97. In addition to this, the Office of Experiment Stations had an appropriation of $125,000 for the past fiscal year, including $12,000 for the Alaska experiment stations, $10,000 for the Hawaiian investigations, $5,000 for the Porto Rican investigations, $15,000 for nutrition investigations, and $50,000 for irrigation investigations. The value of additions to the equipment of the stations in 1901 is estimated as follows: Building, \$133,420.77; libraries, \$26,153.49; apparatus, \$15,009.48; farm implements, \$13,050.45; live stock, \$17,120.29; miscellaneous, \$25,025.10; total, \$229,779.58.

The stations employ 719 persons in the work of administration and inquiry. The number of officers engaged in the different lines of work is as follows: Directors, 53; assistant and vice directors, 15; chemists, 146; agriculturists, 62; animal husbandmen, 14; horticulturists, 78; farm foremen, 21; dairymen, 31; botanists, 49; entomologists, 48; zoologists, 6; veterinarians, 29; meteorologists, 14; biologists, 7; physicists, 5; geologists, 5; mycologists and bacteriologists, 21; irrigation engineers, 8; in charge of substations, 12; secretaries and treasurers, 29; librarians, 11; clerks and stenographers, 40. There are also 72 persons classified under the head of 'miscellaneous,' including superintendents of gardens, grounds and buildings, apiarists, plant and animal pathologists, herdsmen, poultrymen, etc. Three hundred and nineteen station officers do more or less teaching in the colleges with which the stations are connected.

The activity and success of the stations in bringing the results of their work before the public continue unabated. During the year they published 445 annual reports and bulletins, which are many more than are required by the Hatch Act. These were supplied to over half a million addresses on the regular mailing lists. A larger number of stations than formerly supplemented their regular publications with more or less frequent issues of press bulletins, and most of the stations report a large and constantly increasing correspondence with farmers on a wide variety of topics.

FOREIGN EXPERIMENT STATIONS.

Instances of governmental activity for the advancement of agriculture in other countries are numerous, both in the Old World and the New.

The Russian department of agriculture and Imperial domains has inaugurated a system of commissioners of agriculture who will correspond in a general way to our commissioners of agriculture or to our secretaries of State boards of agriculture. Each commissioner's office will have connected with it a corps of agricultural specialists, who will work among the landowners and peasants. The Russian department of agriculture and Imperial domains is also displaying considerable activity in its soil and forestry investigations and in the establishment of stations for the investigation of special subjects, such as the growing of flax, cotton, olives, etc.

In Australia the Victoria department of agriculture is undergoing reorganization. The Victoria royal commission on technical education has brought to a close its study of Australian, European and American departments of agriculture, agricultural schools, and experiment stations, and published its final (sixth) report. The minister of agriculture is now seeking a director of agriculture, who will proceed to reorganize the department and put it on a better working basis.

In England the board of agriculture has made larger grants than formerly to agricultural colleges and societies for conducting agricultural investigations. The agricultural education committee is doing important work for agriculture and agricultural education by publishing circulars on various topics and nature study leaflets for teachers. During the year Mr. John S. Remington has established the Aynsome Experiment Station at Lancashire, a private institution.

The Austrian Government has recently

established several experiment stations, notably the station for plant culture at Brünn, the station for investigations in plant and animal production at Otterbach, and an agricultural physiological station, with divisions of chemistry, physiology and bacteriology, at Prague. In Hungary an experiment station for the analysis and study of wines was established last year at Fiune.

France has established at Nogent-sur-Marne a colonial garden to have administrative control over French colonial stations and botanic gardens in different parts of the world and to furnish these institutions with seeds and plants. During the year œnological stations have been established at Toulouse and Beaune and an agricultural station at Besançon.

In Germany five years of successful work at the Lauchstadt Experimental Farm, which is connected with the agricultural chemical experiment station at Halle, has given so much evidence of the value of experimental farms in connection with experiment stations that there is a movement in that country toward the extension of the so-called 'American system' of field experiments, conducted on a large scale and in a more practical way than has hitherto been customary in that country. Two new stations have been established during the year, a flax-culture station at Sorau and a viticultural experiment station at Weinsberg.

In the West Indies and South America also the claims of agricultural education and research have received much attention. The department of agriculture in the West Indies has established three new stations at Montserrat and one at Tortola, and has conducted several meetings of planters and investigators, at which great interest in the advancement of agriculture was displayed. The Bolivian Government has established an agricultural college at Cochabamba and an agricultural school for Indians at Umala. Brazil has recently established a botanical garden and experimental demonstration field at San Vicente, and the Argentine Republic has decided to establish four experiment stations on the same general plan as those in the United States.

A review of the progress of agricultural research during the year would not be complete without mention of the organization of a department of agriculture, with a small staff of experts, at Bangalore by the government of Mysore, India; the establishment of a dairy station at Gembloux, Belgium; a veterinary pathological institute and animal vaccine institute at Christiania, Norway; and an irrigation experiment station at Calgary, Canada.

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OFFICE OF EXPERIMENT STATIONS,
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SCIENTIFIC BOOKS.

Mechanical Drawing. By F. W. BARTLETT, Lieutenant Commander, U. S. Navy. New York, John Wiley & Sons. Pp. viii + 190.

Although this book has been prepared primarily for students of the United States Naval Academy at Annapolis and indicates some of the distinctive features of the course in that institution, it must prove highly serviceable to the general student about to begin drafting. Without including either geometry or descriptive geometry—courses in which are given in another department of the Academy—the author restricts himself to the presentation and application of those practical methods which have commended themselves to the experts of the various departments of construction. The following, from the preface, will indicate the divisions cited: "As general methods differ slightly, the drawings referred to for the general instruction have been those of the Bureau of Steam Engineering of the Navy Department, and the methods of that Bureau have been followed. The special methods of the Bureau of Ordnance and of the Bureau of Construction are studied and used after the main course is completed."

One hundred and five of the hundred and ninety pages are devoted to a description of the drawing outfit, and to general directions as to its use. This portion alone is, fortunately, worth the cost of the book, for without the sectional models, which are referred to in the later pages and which form so valuable a feature of the Annapolis system, the outside student can hardly derive all the discipline intended from a course based on this work. Preliminary to the work from models two sheets of elementary plane figures are required, the first containing eighteen three-inch squares, filled with straight-line designs only. The second sheet affords about the same amount of practice with compass and irregular curves.

The book is well and practically illustrated, except in the matter of lettering, in which a standard far too low is set for Government work, not comparing at all favorably with that either of the leading bridge and locomotive companies, or of the draftsmen of the Coast and Geodetic Survey. As a whole, the book is a valuable addition to the literature of graphic science, and is likely to prove especially useful to teachers as a reference work.

Frederick N. Willson.

Princeton, N. J.

Preliminary Catalogue of the Crosby-Brown Collection of Musical Instruments of All Nations. I. New York, The Metropolitan Museum of Art, 1901. 8vo. Pp. 94, pl. 12.

This little work deserves a hearty welcome both for what it is and for what it forecasts in the future. All persons interested in tracing human development through the ages should know of this splendid collection of more than 2,500 instruments, nearly all presented by Mrs. John Crosby-Brown; the more one knows of it, the more he will feel the need of interpretation. This need is partly met in the sumptuous volume published in 1888 by Mrs. Brown and her son, Professor William Adams Brown, 'Musical Instruments and Their Homes.' Necessarily the work was mainly a compilation from writers of all degrees of competency, and since its date considerable new matter has become available, especially on the scientific side of the subject.

The present pamphlet has a more modest aim. It is a Catalogue of Gallery 27, which contains the Asiatic instruments. Great care has been taken to get the names properly spelled. The arrangement is first by countries, and then by cases; generally a very few lines of description and the dimensions of the instrument follow each title; there is no musical notation. The page is clear, the matter well displayed, and the proof-reading excellent. A full index of names, native and English, is provided. Twelve fine half-tone plates add much to the value of the book, and furnish beauty and instruction to those who cannot visit the Museum. Two of the plates show the Cristofori piano, the finer of the only two existing instruments made by the inventor of the piano. Of great interest to the student of scales is the half-page view of case 11, showing nearly twenty Japanese flutes with equally spaced holes, and several Pan's-pipes and xylophones that display a rectilinear or symmetrical construction, rather than a conformity to a law of reciprocals like ours. Those who believe there has been a universal desire for a diatonic scale will find it difficult to explain or explain away the facts that confront them in this case.

The future instalments of this catalogue will be awaited with interest; and when it is completed we trust the author's hope may be realized 'to issue an illustrated catalogue in which full justice shall be done to the many features of interest in the collection.' For 'full justice' means a work such as has never been attemped—such a work needs not merely a musician as Fètis or Engel or an instrument maker like Mahillon, but it needs the cooperation of the archeologist and ethnologist, the physicist, the philologist and the psychologist; and if the philosopher and the artist feel that they too have something to add to the understanding of musical instruments and of the men that made and used them, who shall deny the claim? The unprecedented opportunity before the Metropolitan Museum and its liberal patron leads one to look for results far more full and satisfying than have yet been secured.

CHARLES K. WEAD.

SCIENTIFIC JOURNALS AND ARTICLES.

The Popular Science Monthly for June contains a series of papers 'On the Definition of some Modern Sciences,' presented originally before the Philosophical Society of Washington. The 'Introduction' is by W. H. Dall; Carroll D. Wright defines 'Statistics,' Roland P. Falkner 'Political Economy,' E. A. Pace 'Psychology' and Lester F. Ward 'Sociology.' Marshall O. Leighton discusses 'The Commercial Value of Human Life,' concluding that the pecuniary value of life is subject to the same economic laws as are applied to other commodities. 'Instinct' by Douglas A. Spaulding is a reprint of much value, as it contains the record of a series of important experiments on young birds which seem to prove that instinct is indeed inherited memory. Arthur C. Scott has an article on the 'Educational Value of Photomicrography,' describing some of the methods used and showing some of the results obtained. John Waddell considers 'Sugar and the Sugar Beet,' stating that the profits of beet raising average twenty dollars per acre. There is a biographical sketch of 'Peter Guthrie Tait' by C. K. Edmunds and J. McKeen Cattell presents some very decided ideas 'Concerning the American University.' There are also some good brief articles under 'The Progress of Science.'

IN *The American Naturalist* for May Henry F. Osborn discusses 'The Law of Adaptive Radiation,' the differentiation of habit in several directions from a primitive type. One of the conclusions reached is that function precedes structure. Charles T. Brues describes some 'New and Little Known Guests of the Texan Legionary Ants,' and in 'The Structure and Classification of the Tremataspidæ' William Patten presents the evidence for the arthropod affinities of the primitive 'fishes,' proposing for *Pterichthys* and allied forms the new class Peltacephala. Elliot W. Downing considers 'Variation in the Position of the Adductor Muscles of *Anadonta grandis* Say.' The number contains the Quarterly Record of Gifts, Appointments, Retirements and Deaths.

The Plant World for April contains 'Suggestions for the Preservation of Our Native Plants' by F. H. Knowlton, 'Among Florida Ferns' by A. H. Curtiss and shorter articles and reviews. In the Supplement Charles L. Pollard treats of the families of the Orders Primulales and Ebenales and begins that of the Gentianales.

Bird Lore for May–June opens with an article on 'The Increase of the Chestnut-sided Warbler' by A. Radclyffe Dugmore, illustrated with reproductions of some good photographs by the author. Francis H. Herrick writes of 'The Chebec's First Brood,' and Gerard A. Abbott describes 'A Grebe Colony.' The fourth paper of the series 'How to Name the Birds,' by Frank M. Chapman treats of the Tanagers, Swallows, Waxwings and Shrikes. The shorter articles, including notes, reviews and editorial comment, are all interesting.

The Museums Journal of Great Britain for May contains a description of the new Glasgow Art Gallery and Museum, which was an outcome of the successful international exhibition of 1888. The cost will be not far from $1,250,000. There is a series of notes on 'Some South African Museums' which shows that steady progress is being made in natural science, and the balance of the number is taken up with notes on British and foreign museums.

SOCIETIES AND ACADEMIES.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 553d regular meeting was held May 10, 1902, Vice-President Gore in the chair.

The first paper was by Dr. S. P. Langley, 'On the Laws of Nature,' is printed in the current issue of SCIENCE.

Mr. C. G. Abbot, of the Smithsonian Astrophysical Observatory, then read a paper on 'The Relation of the Sunspot Cycle to Meteorology.'* The author admitted as proved

* This paper will appear in the *Monthly Weather Review* for April.

that terrestrial magnetism and electricity, including the aurora, are directly affected when sunspots appear, and that while the evidence is less simple in the case of the meteorological elements, temperature, pressure, humidity and rainfall, there is a strong probability that they too are somewhat affected along with the sunspot frequency.

While admitting the possibility that magnetic and electrical disturbances are the causes of these meteorological changes attention was devoted only to the often made suggestion of a variability of solar radiation as an explanation of the supposed meteorological effects. Lockyer's views were discussed, and Halm's theory mentioned. It was pointed out that there is a ready way of determining whether changes of transmissibility in the solar atmosphere exist as required by Halm's theory. The great hindrance offered by the earth's atmosphere to direct measures by the actinometer of the variability of solar radiation was pointed out, and the variations noted in the results obtained at Montpellier since 1883 were attributed to the influence of water vapor. It was, however, pointed out that spectral actinometry by the aid of the spectro-bolometer might be more conclusive.

Professor C. Abbe presented the next paper. He said Professor A. Wolfer, who now succeeds Professor A. Wolf as Director of the Federal Observatory at Zurich, has lately revised the so-called Tables of Numbers expressing relative sunspot frequency, and has communicated the results of this revision to the Weather Bureau. By incorporating a number of newly discovered observations, especially a long series made at Kremsmunster, and by revising all computations so as to eliminate numerical errors, Professor Wolfer is now able to present a greatly improved table of numbers for each month from 1740 to date, and a list of the dates of each maximum and minimum since the days of Galileo. There is no evidence from this table of the thirty-five-year period, but a slight periodicity of fifty-five years is apparent. The intervals from minimum to maximum are always shorter than from maximum to minimum; that is to say, sunspots increase more rapidly than they decrease; moreover the intensity of a maximum is greater in proportion as the rate of formation of sunspots is greater. Professor Newcomb's studies on the sunspot period remain unaltered by the revision.

The communication will be published in full in the next number of the *Monthly Weather Review*.

The 554th regular meeting was held May 24, 1902, Vice-President Marvin presiding.

Mr. L. A. Bauer called attention to the remarkable magnetic disturbances now occurring, although this is near a sunspot minimum, and to simultaneous disturbances recorded at Cheltenham, Md., in Kansas and in Honolulu on April 18, the date of the Guatamalan earthquake; and to other disturbances closely coincident with the Martinique outburst. A fuller report of this matter will appear in Science.

The first regular paper was by Mr. G. K. Gilbert, 'On the Mechanism of Volcanoes.' The speaker said the matter to be presented was timely rather than novel. He accepted generally Major Dutton's views, but illustrated them by various instances from his own observations. The first problem is why the lava comes up: the primary force is gravitation, and the column of lava must exert less pressure in the depths than the neighboring solid rocks; accordingly the heavy, basic lavas, as basalt, in order to become light enough to rise must be highly heated, and are then very fluid; while the lighter, acid lavas rise in a very viscous condition, and flow slowly. The flow ceases because the supply of material lighter than the crust runs out. It is not yet clear how the liquid pierces the crust. Eruptions are of three kinds: dry, and then the lava flows quietly out of the crater or fissures; or wet, and then the occluded water expands into steam as the lava rises, thus forming a porous mass, as pumice, and liberating dense clouds; or explosive, as at Krakatoa, under conditions not well understood. Considerable discussion followed the paper.

Professor A. F. Zahm then read a paper on 'New Methods of Experimentation in Aerodynamics,' outlining a portion of the researches of Mr. Mattullath and himself at the Catholic

University of America, and describing the equipments and instruments of the laboratory of aerodynamics recently erected there by Mr. Mattullath. Both gentlemen have been working on similar problems for many years, and Dr. Zahm was Secretary of the Aeronautical Congress at Chicago in 1893. On the floor of the laboratory is a wooden tunnel fifty feet long by six feet square in cross section, having a five-foot suction fan at one end and a netting, or two, of close mesh at the other. A wind is thereby generated of practically uniform velocity and direction, the speed varying less than one per cent., the direction but a small fraction of a degree. In this current are held objects whose resistances, lift, drift, skin-friction, etc., are to be measured. Among the various anemometers and wind-balances designed for this purpose, is a pressure gauge graduated to millionths of an atmosphere, and which may be adjusted to read to less than one ten-millionth. It is connected by hose to one or more Pitot nozzles, and is used to measure the air velocity and pressure at all points of the stream, particularly in the neighborhood of the exposed body. The prime motive of these investigations is to furnish a basis for calculations in aeronautics, particularly in the theory of mechanical flight.

The Society then adjourned till October 11, 1902.

CHARLES K. WEAD,
Secretary.

DISCUSSION AND CORRESPONDENCE.

VOLCANIC DUST AND SAND FROM ST. VINCENT CAUGHT AT SEA AND THE BARBADOS.

SOME days ago the Weather Bureau forwarded to the Geological Survey for examination a package of volcanic dust which had been collected May 7 at sea on board the British steamship *Coya* by Capt. Thomas in latitude 11° 21′ N., longitude 57° 47′ W., or about 275 miles southeast of the island of St. Vincent, W. I. The dust began to fall about 10 p. m. May 7, and Capt. Thomas reports it thickest between midnight and 2 a. m. May 8th. At 1:30 p. m. local or sun time there was absolute darkness. The dust was supposed by Capt. Thomas to have resulted from the eruption on Martinique or St. Vincent. The upper currents of that region during May 5, 6 and 7 were reported west with easterly surface winds. The transfer of the dust is therefore probably due wholly to upper currents, but the matter cannot be advantageously considered until the facts of distribution over the whole field are available.

The material is yellowish-gray in color, and to the naked eye of remarkably uniform fineness, having been thoroughly assorted from the larger fragments in its long flight. The gritty feel suggests that its particles are sharp and angular, and so they are, in strong contrast with the smooth round grains of the wind-blown desert sands which roll upon the surface.

The particles are so small that a microscope must be used for their study and reveals a range in their size from a diameter of .3 mm. down to .001 mm. or less. The largest particles have a sp. gr. of 2.7, with others almost as large having a sp. gr. 3.3. Considering the great distance this dust traveled through the air before falling to the vessel, it is suprising that it sinks so rapidly in water. Stirred into distilled water and allowed to stand, in five minutes fifteen per cent. falls to the bottom, in ten minutes fifty-seven per cent., in ninety minutes ninety-seven, and yet this material traveled through the air 275 miles. It must have been hurled up very high and carried away by strong currents.

The dust is a mixture of crystal fragments and glass and is clearly of volcanic origin. The crystal fragments constitute about sixty per cent. of the whole mass, and embrace feldspar, pyroxene, magnetite and possibly a number of other minerals not readily identified under such conditions. Feldspar is by far the most abundant mineral, occurring frequently in cleavage plates some of which show well-defined albite twinning, while others probably parallel to a different cleavage do not. The extinction angles, which rarely rise to twenty degrees, indicate that the feldspar approximates labradorite or bytownite, although there may be some orthoclase present. Many of the feldspar grains are full of included glass and other matter at times arranged in bands to mark zones of crystal growth. Quartz and orthoclase may be present in small quantities but they could not be positively determined.

Apparently two forms of pyroxene are present, a pale green non-pleochroic form whose prismatic fragments extinguish at a large angle and is probably augite, and a pleochroic yellowish form like hypersthene, but apparently having inclined extinction.

The glass particles vary greatly. Many are perfectly clear and transparent but rarely show the concave boundaries which are commonly characteristic of glossy volcanic dust. Occasional clear fragments are filled with microlites, minute crystals whose development was arrested by the eruption.

Opaque, white or yellowish-gray pumiceous fragments full of gas cavities are common and give color to the mass of which they constitute nearly twenty-five per cent. They appear to represent the molten material which floated the crystals and contained the explosive energy of eruption, blowing the mass to sand and dust with the relief of pressure. Although it is possible that the dust came from several sources, there is as yet no certain means of distinguishing the material from the different sources, nor in fact is there in the dust itself a definite suggestion of more than one source. In the process of crystallization the occluded gases are in large measure rejected and concentrated in the amorphous portion of the mass, so that when an outbreak occurs the glassy parts record the greatest expansion. The great distance traveled makes it probable that the proportion of amorphous material here is greater than in the original magma, for the crystal fragments being heavier would drop more readily than those of glass.

The destruction of St. Pierre has been attributed largely to gases shot out from the volcanic vent with burning sulphur, and it is probable that the gases ejected by la Soufrière on St. Vincent were of a similar nature. To get evidence concerning them it was proposed to crush the fragments of pumice in a vacuum and liberate the enclosed gases for chemical investigation, but the amount and character of the material at hand was entirely inadequate.

An inquiry as to the presence of soluble salts in the dust gave more definite data. None of the dust components thus far enumerated are soluble in water nor has it a decided taste, and yet when 10 grammes of the dust were treated with 400 cubic centimeters of water for 2 hours on water bath a neutral solution having the composition noted below with proportions indicating that the substances dissolved were $CaSo_4$ and NaCl and constituted about .5% of the dust. They were not discerned with certainty under the microscope but are supposed to appear as coatings deposited on some of the grains during the eruption. The large amount of superheated water vapor usually given off by volcanic eruptions is generally accompanied by much hydrochloric (HCl) and sulphurous acids (So_2), sulphurated hydrogen (H_2S) and other gases. The sulphurous acid upon reaching the air partially oxidizes to sulphuric acid, and with the hydrochloric acid would naturally attack the shattered lime-soda feldspar fragments forming a coating film of gypsum and common salt.

CHEMICAL ANALYSIS OF DUST FROM THE COYA I. AND OF HYPERSTHENE ANDESITE II. FROM CRATER LAKE, OREGON.

	I.	II.
Soluble in water.		
CaO	.20	
$(AlFe)_2O_3$	none	
Na_2O	.08	
SO_3	.29	
Cl	strong trace	
Insoluble in water.		
SiO_2	57.62	58.41
Al_2O_3	19.76	17.85
Fe_2O_3	3.43	2.67
FeO	3.90	3.29
MgO	1.82	3.61
CaO	6.25	6.81
Na_2O	3.79	3.77
K_2O	.71	1.23
H_2O-	.41	.34
H_2O+	.59	.86
TiO_2	.87	.69
CO_2	none	
P_2O_5	.17	.24

S	.11	
SO_3	none	
MnO	.08	trace
	100.08	99.77
		.05 (BaO)
		.05 (SrO)
		99.87

Native sulphur is abundant at Mt. Pelee as at many other volcanic vents and results from the reaction of the escaping gases SO_3 and H_2S. The last mentioned gas is readily inflammable and like SO_3 and HCl with which it is commonly associated issuing from volcanoes it is deadly and quickly proves fatal when inhaled in large proportions. To these heavy gases, in part inflammable, most likely commingled with others, is probably due the sudden destruction of life at St. Pierre.

The above chemical analysis I. by Mr. Steiger shows the presence of .11% sulphur in the insoluble portion of the dust. Tests with carbon disulphide indicate that the sulphur is not free but probably in the form of sulphides. No trace of boracic acid could be found, nor of ammonia or carbonic acid. Salts of ammonia and carbonates are formed only at low temperatures and would fail to leave a record among the solid compounds. Tests for arsenic and antimony were negative also.

By the kindness of Mr. W. C. Douglas, of the Geological Survey, I obtained a sample of the sand which fell at the Barbados, ninety miles from St. Vincent (one hundred and twenty from Martinique) on the afternoon of May 7. It was collected by Mrs. Mary D. Aughenbaugh, whose interesting observations are published in the *Evening Star*, Washington, D. C., May 23, p. 7: "Although the volcanic dust from St. Vincent was coming from the west there was a fairly strong east wind blowing all the time interspersed with hot waves of sulphurous air. The volcanic dust rained continuously here in Barbados from four o'clock P.M. Wednesday, May 7, until Thursday morning at five o'clock and accumulated to a depth of three fourths of an inch."

The particles of sand collected at the Barbados are of the same material as those noted in the dust collected by Capt. Thomas, although differing in proportion, and they evidently came from the same source, traveling between Barbados and the Coya in 6 hours, at the rate of nearly 31 miles an hour. Magnetite appears to be somewhat more abundant and much of it is enclosed in glass. The largest particles have a diameter of about .6 mm. with an average of .3 mm., and therefore a mass of over eight times that of the particles noted above borne to a distance three times as great. The sand from Barbados contains a much larger proportion of crystal fragments than the dust from the Coya, for the glassy matter is less than twenty per cent. The dust and sand from St. Vincent drifted mainly to the eastward, for the fall at Kingston, on the southwest side of St. Vincent, as reported by Mrs. Aughenbaugh was about as great as at Barbados, 90 miles away.

When compared with the dust and sand furnished by other volcanoes in recent years it bears the closest analogy with that of the Bogoslov eruption in Behring's Sea, October 23, 1883, and collected at Unalaska, sixty miles away. Mineralogically the sands are somewhat different and that at Unalaska is the coarsest, but they are alike in having a decided predominance of crystal fragments over those of volcanic glass. On the other hand, the dust from the great eruption of Krakatoa in the same year wafted many thousands of miles from its source was composed chiefly of glass particles, and crystal fragments formed a very small part of the mass. The explosion at Krakatoa was much greater than those of St. Vincent and Martinique. In both cases there was molten rock material erupted by the explosion, although at Krakatoa there was no flow of lava. In Japan, however, a few years ago the only material erupted was mud, giving evidence of the action of steam without real fusion. The character of the dust and sand examined is such as to indicate that if they were accompanied by lava streams upon the surface the streams would be similar to many flows in the Cascade Range of Oregon instead of the mud flows of Bandaisan in Japan. The similarity is well illustrated by a chemical analysis given above (II.), made by H. N. Stokes of a hypersthene-augite andesite of Crater lake.

J. S. Diller,
George Steiger.
U. S. Geological Survey.

THE GRAY SQUIRREL AS A TWIG-PRUNER.

Last year my attention was called to some elm street trees in New Haven, which had been injured by having the twigs eaten off early in June. The twigs were cut off through the hard wood formed the previous season, just below the new growth. Under certain trees the ground was fairly covered with the detached twigs. No borers were found in the severed portions as is the case when infested by the oak pruner, *Elaphidion villosum* Fabr., which attacks several kinds of shade trees. Still, it was supposed that some insect caused the damage, as climbing cut-worms sometimes eat off the new growth—but usually through the soft tissue.

The present season, similar injury has been reported from Farmington and New Haven.

On May 23, while cycling through the streets of New Haven, I noticed a small elm tree under which the ground was covered with freshly severed twigs. The same tree was attacked last year. Four gray squirrels were seen in the top busily engaged in devouring the nearly ripe seeds. As the seeds of the American elm are near the extremity of last season's growth where the twigs are very slender, the squirrels were obliged to perform many noteworthy acrobatic feats in order to obtain the seeds. Some were hanging by the hind feet from slender branches to reach twigs beneath them, and all were munching away at the seeds as if half starved. In some cases they were not able to reach the clusters of seeds, and would bite off the twigs, which dropped to the ground where they could find their food later. Several twigs were dropped in this way in a period of about two minutes, while the writer was watching them. In some cases the squirrels cut off twigs from which they had already eaten the seeds. Trees bearing no seeds are not pruned in this manner, and none of the trees will probably be injured very seriously. This habit of squirrels may have been recorded by other observers, but I do not remember seeing it in print.

The best remedy seems to be to provide the squirrels with plenty of other food at this season of the year when their natural food supply has been nearly exhausted.

W. E. Britton.
Conn. Agr. Experiment Station.

W. E. HAMILTON.

In Chatham, Ontario, there died a short time ago William Edwin Hamilton, the elder son of Sir W. R. Hamilton, the great Irish mathematician. He gave his father some help in reading the proof sheets of the 'Elements of Quaternions,' and his name appears as editor on the title page of the first edition. As the book had been printed off in sheets under the care of his father, his work as editor of the posthumous volume did not amount to much. He had graduated B.A. at Trinity College, Dublin, and had been trained to the profession of civil engineer. The editing finished, he left for the West Indies, located in various parts of the New World, and finally settled down in Chatham, then the center of immigration to the peninsula of Ontario. He was employed on the newspaper of the town, and through drinking habits fell into very wretched circumstances. When I first saw him, underclothes were conspicuous by their absence, and his sleeping place was said to be the loft of a livery stable. By taking the gold cure he was able to master his alcoholic enemy; but no cure could recall or even make up for the years he had wasted. Every Saturday he might be seen distributing a leaflet of a newspaper called the *Market Guide,* which contained advertisements, a list of prices of farm produce, a few witticisms, and occasionally some doggerel verses which he called poetry. In his later years he lived poor but respectable. He loved to talk about the members of that brilliant society in which his father moved, and he had not a few friends who esteemed him, if not for his own, at least for his father's sake. He was about sixty years of age, and his death was very sudden.

Alexander Macfarlane.

CORRESPONDENCE OF RAFINESQUE AND CUTLER.

TO THE EDITOR OF SCIENCE: Apropos of the letter from Rafinesque to the Rev. M. Cutler, printed in SCIENCE of May 2 (pp. 713, 714), allow me to point out that another letter from Rafinesque to Cutler will be found in Cutler's 'Life, Journals and Correspondence,' 1888, II. 311–314. This letter is dated Palermo, January 28, 1807, and is signed 'C. S. Rafinesque-Schmaltz, Chancellor of the American Consulate, Palermo.'

ALBERT MATTHEWS.

BOSTON, May 3, 1902.

MASS AND WEIGHT.

TO THE EDITOR OF SCIENCE: In view of the wide interest at the present time in the subject of measurement and in view of the probable change soon to be made in the national system, I beg to call attention to the great need for a radical change in the title used.

It has long been denoted a system of 'Weights and Measures.' This title, it seems to me, gives much undue importance to the idea of weight which is only a particular kind of a force. The weight idea is of little use except as a convenience in comparing masses at a single location. A standard of weight is of no real value, since weight is only the earth's attraction of a body, and depends upon the latitude, altitude, etc., of the body. Furthermore, since weight is only one of the many measurable quantities, what more is implied in the title 'Weights and Measures' than in the simple term *measurement?*

Commercially, the quantity of matter concerned, *i. e.*, the mass, is the real thing of importance; the balance being merely a convenient apparatus for comparing and so determining the relative values of masses.

I urge due consideration of this topic by all interested, feeling that a change in the wording of an old title is very desirable, and that the proper time to bring this about is the present. I suggest that the title 'Measurement' be employed in place of what seems to me the inappropriate term 'Weights and Measures.'

ARTHUR W. GOODSPEED.

RANDAL MORGAN LABORATORY OF PHYSICS,
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SHORTER ARTICLES.

A SUPPOSED EARLY TERTIARY PENEPLAIN IN THE KLAMATH REGION, CALIFORNIA.

IN another paper, now in preparation, the writer will endeavor to show that remnants of an erosion base level equivalent to the late Tertiary peneplain of the Sierra Nevada region may be identified in the Trinity basin, between Trinity Center and Weaverville, in Trinity county, California, at an altitude of about 3,800 feet. While it yet remained a lowland plain, there rose abruptly above it on the west of the Trinity River the serpentine, granodiorite, gabbro and schist peaks of the Sierra Costa Mountains. Climbing to the summit of one of these peaks, we see what appear to be evidences of an older base level, a dissected peneplain.

With all its ruggedness and deep erosion, the Sierra Costa range is virtually a dissected plateau, about fifty miles in length in a direction north of east and twenty miles in average width. The principal peaks attain about the same altitude and none rise prominently above a general level. There is among them the regularity which we should expect from a very old peneplain which has been almost destroyed by erosion. There is nothing in the structure to explain this regularity, as the region is one mainly of huge *massifs* of serpentine, gabbro and granodiorite intruded into each other, with a belt of highly tilted schists on the southwest and limited areas of slate and greenstone toward the northeast.

From a position on the divide between Coffee Creek and its north fork, one of the high mountains between Trinity River and its east fork presents the appearance of an elevated plateau which one imagines to be about one square mile in area. From Grizzly Peak, a prominent mountain standing at the northeastern corner of the McCloud-Pitt projection of the Klamath region, one can look over all the mountains as far west as the Sierra Costa range, and this latter being so far distant, the valleys are not seen, but the peaks coalesce to form a crest-line whose evenness is startling to one used to the irregularity of Klamath topography.

These are the only evidences yielded by the Sierra Costa range similar to those usually depended on in the Mississippi basin to establish a dissected peneplain, and they may be deceptive, for it is not certain that the comparative uniformity in the height of the peaks may not be due to the intersection of slopes in accordance with the theory advanced by Penck. A symmetrical drainage system nearly everywhere trenched down to the late Neocene base level might be expected to reduce all the principal divides to about the same level.

But there is another and stronger evidence of peneplanation at the level of the high peaks. It is to be found in the behavior of the streams. In a general way the rivers and creeks of the Sierra Costa region ignore the structure. For instance, the old Coffee Creek rose in the Abrams mica schist (not very resistant relatively to other formations) flowed obliquely across on to the Salmon hornblende schist (quite resistant), made a sharp turn and then crossed at nearly a right angle belts of mica schist (not resistant), serpentine (moderately resistant), mica schist (not resistant), serpentine (moderately resistant), gabbro (very resistant), serpentine (less resistant), granodiorite (moderately resistant) and serpentine (less resistant). Why was not the stream deflected along the softer belts and around the *massifs* of gabbro and granodiorite if the structure in any way controlled the course?

All the higher peaks in this region are composed of granitic rocks, gabbro or hornblende schist, showing that these three are the most resistant to weathering. All the valleys narrow decidedly upon entering on the area of the gabbro and the hornblende schist showing that these formations are the most resistant to stream erosion. Yet the streams will cross these formations when they might take an easier course around them.

There is another way of looking at it: The granodiorite batholiths were the last to be intruded. They have the form of gigantic volcanic necks, being in most cases vertical columns of granitic rock rising up through the other formations. Whether or not any of the material ever reached the surface and formed rhyolite volcanoes, it is likely that the strata were more or less arched over these *massifs*. The bulging must have been effected so rapidly that any important streams flowing over their sites would be deflected. Without a subsequent rearrangement of the drainage system, the trunk streams should avoid these granite *massifs*, which in some important cases they do not. There can be little doubt that the drainage system of the Sierra Costa area is superimposed on the structure.

The independence of the Sierra Costa streams from the structure was already developed when the drainage was no lower relative to the rocks than the tops of the present peaks. It implies that a rearrangement had occurred previous to the beginning of trenching of the present valleys. Such a rearrangement must have been effected on a plain. When migration of streams is brought about during simple down-cutting or deepening of valleys it is controlled by the structure. A radical rearrangement independent of structure necessitates a plain, either of aggradation or of denudation.

This argument does not establish the connection between such a plain and the uniformity in height of the present peaks. We do not know whether the rearrangement occurred on an uplifted sea bottom (a plain of aggradation) or on a true baselevel of erosion. And if the latter, we do not know whether this baselevel was developed in the plane of the summits of the present peaks or higher in the strata. These are problems to be solved in the future. At present we can only say that the examination of the stream courses indicates that such a peneplain was developed, increasing the probability that the present summits of the Sierra Costa peaks do represent a dissected peneplain.

Very few geologists have climbed to the summit of the Sierra Costa Mountains. Dr. A. C. Lawson had a partial view of the supposed peneplain level from Battle Mountain, altitude about 7,675 feet above the sea. He recognized the pertinence of the evidence and was willing to accept the idea of the dissected peneplain with a very strong element of doubt. Mr. J. S. Diller saw the summit level of the peaks from the top of Mt. Courtney, altitude about 8,800 feet, and he felt very strongly inclined to recognize the supposed eroded base level. As for myself, I have never before ventured to recognize a dissected peneplain on such slender evidence, but I think that in time it will come to be an established fact, although at present I shall refer to it with a question mark.

In the early stages of this investigation I entertained the idea that the dissected peneplain (?) of the Sierra Costa summits was of Cretaceous age, a portion of the same base leveled land surface on the borders of which after submergence the Horsetown and Chico sediments were deposited, but reflection has shown this to be improbable. The peneplain (?) has suffered little deformation over an area fifty miles long and twenty miles wide. It is not likely that such an extensive tract would remain intact while orographic disturbances of the greatest magnitude were occurring in its neighborhood. The inference is that it has been developed at a later date if it is really a feature of Klamath physiography, and must be credited to the early Tertiary times.

That such a peneplain was developed outside of the Sierra Costa area subsequent to the first post-Chico disturbance, over at least that portion of the Klamath region which had been covered by the Horsetown sediments, is evidenced by the behavior of the drainage system of that region. The northward drainage of the district between the Bully Choop range and the Trinity River was apparently inaugurated by the post-Chico disturbance, but since then there has been somewhat of a rearrangement of the system. A trunk stream ought to follow the line of basins marked by the four Cretaceous remnants south of the Trinity River, but, instead, all the main creeks cross this line and traverse the structurally higher ground on the north. Moreover, several of the most prominent streams as the Hay Fork, Salt Creek and the South Fork of Trinity River cross the line along the structural ridges which separate the basins, while one of the largest Cretaceous remnants constitutes the divide between two important creeks, Hay Fork and Salt Creek. The Indian Creek Cretaceous area is crossed by three parallel creeks, Indian, Reading and Brown's, separated by low divides where they are composed of the soft Cretaceous strata, yet these creeks traverse a high broad mica schist ridge in deep narrow gorges on their way to Trinity River. The drainage could not very well be more independent of the structure either of the metamorphic rocks or of the post-Chico deformation. It seems that the surface of this region was planed down and the streams then migrated and adopted the shortest course to the great trunk stream flowing west (or east) midway between the present Bully Choop range and the Sierra Costa range.

This rearrangement was not effected on the late Neocene surface (correlated with the Sierra Nevada peneplain), as the country of that time at some distance away from the main streams was too hilly. It seems rather to have been the result of the disturbance of an earlier peneplain—what more natural than to correlate it with the supposed dissected peneplain of the Sierra Costa summits!

In the extreme southwestern part of Oregon and in the adjoining section of California, Diller* has discriminated a dissected peneplain surface which truncates the tilted Miocene strata and hence is of late Tertiary age. It is best developed on the rocks of the Coast Range region, but also penetrates the Klamath region. Standing on one of the higher summits of the Sierra Costa range, as Mt. Thompson, altitude 9,345 feet, or Mt. Courtney, altitude about 8,800 feet, this peneplain is well displayed. It is marked by a general evenness of the surface of the mountain ridges which in the far distance merge into an apparent plain. It is as well preserved as one of the dissected peneplains of the Eastern States. The whole country to the westward of our position seems to have a general and even slope toward the west-southwest. There are a few monadnocks in sight, notably Preston Peak near the Oregon line.

* Coos Bay Folio of the Geologic Atlas of the United States.

Now the curious feature about this view is that the supposed dissected peneplain of the Sierra Costa mountains seems continuous with the more western peneplain, *which must be deceptive.* Taking into consideration a great arching of late Pliocene or early Pleistocene age which the uplifting of the Neocene channels in western Trinity and Siskiyou counties makes practically a certainty, we shall see that there cannot be a gradual and even slope in an older peneplain from the Sierra Costa Mountains to the sea. The peneplain (?) of the Sierra Costa summits should rise up several thousands of feet west of Mt. Thompson before beginning its slope toward the ocean. Instead, the general surface drops away rapidly at the western edge of the Sierra Costa Mountains and no peneplain is represented for some miles westward. This fact is not at first appreciated, and hence the impression that the peneplain west of this eroded area is the same as that supposed to pass through the Sierra Costa summits.

My explanation is that the Sierra Costa peneplain (?) has been destroyed throughout the country west of Mt. Thompson, but that a later and lower peneplain was developed in that direction. This will be tentatively correlated with the late Pliocene base level of the old Trinity valley, because it is below this western peneplain that the deep Sierran valleys are trenched. The arching of the surface, to which is apparently due the deep gorges of the lower Trinity and Klamath rivers brought up this later peneplain to such a level as to make it appear a projection of the Sierra Costa peneplain (?).

The latter, if it ever existed, is regarded as virtually destroyed throughout the Klamath region except over the Sierra Costa Mountains and a few outlying ridges and peaks. In a general way, the Marble Mountain range and a part of the Siskiyou range seem to answer the requirements of such remnants. It is possible also that the Yallo Ballo Mountains, Bully Choop Peak, the Towerhouse Bally and some of the higher points of the Rogue River range may reach nearly to the old peneplain (?) level; but all the remainder of the Klamath area was reduced much below that level by the close of the Tertiary era.

There has been too much generalizing in the past on the subject of Klamath physiography, and this paper, by intimating some of the complexities of the problem, may be considered a protest against it.

Oscar H. Hershey.

Berkeley, Cal.,
Nov. 14, 1901.

THE RATE OF INTEREST ON GOVERNMENT SECURITIES.

McCoy's Tables, issued by the Treasury Department at the commencement of each month, exhibiting the market prices and investment values of the securities of the United States, attract little attention from the public or the press and yet they contain the most perfect measure of the business conditions, the healthfulness of the industries and the public credit that can be found. The issue of June 2, giving the figures for the month of May, has just come to hand. There are five issues of securities, the 'consols' of 1930, the Loan of 1908–18, the Funded Loan of 1925 and the Loan of 1904. These bear, respectively, 2, 3, 4, 4 and 5 per cent. interest and mature at the latest of the dates given above for each. Interest is payable quarterly.

The Two-per-cents of 1930 sold at an average of 109.5375, netting to the purchaser an average of 1.587 per cent. The Threes of 1908–18 sold at 108.4775, bringing in 1.584 per cent. The Fours of 1907 brought 110.3225 earned, net, 1.784. The Fours of 1925 give the figures 137.3920 and 1.957. The Fives of 1904 similarly give 105.8237 and 1.547.

The Fives of 1904 have the highest price of any securities, governmental or private, now in existence or which ever were known in history. The credit of the United States, at this moment, stands higher than that of any other nation, contemporary or of earlier times. The Two-per-cent Consols measure that credit perhaps more accurately than any other of these securities and are sold at a higher figure than ever were any such securities in the history of finance. During this period the rates for time-loans in the New York market were usually from four to four and a half per cent. for the best paper, Government securities thus indicating practically double the value of private credit. British consols sold at 96⅝, French *rentes* at 101.225, German 3½ per cent at 102, Spanish Fours 78¼ in London. Foreign Municipal Fours sell at par. During the same period the best railroad Four-per-cents sold in New York at about 105 and the Fives at 125.

RAILWAY ARRANGEMENTS FOR THE PITTSBURGH MEETING OF THE AMERICAN ASSOCIATION.

THE Local Committee for the Pittsburgh meeting of the American Association for the Advancement of Science and Affiliated Societies hereby announces the final arrangements made with the various Passenger Associations regarding rates and conditions connected with the purchase of tickets and extension of time limits.

The *Central, Trunk Line, Western,* and *New England Passenger Associations* have granted a rate of one fare and one third for the round trip, on the certificate plan.

Tickets at full fare for the going journey may be obtained from points within the territories of the *New England, Trunk Line,* and *Central Passenger Associations,* from June 19 to June 30 and from points within the territory of the *Western Passenger Association,* from June 19 to June 25 inclusive.

Delegates to the meeting should bear in mind the necessity of obtaining a *certificate* from the office where the ticket is bought. Do not make the mistake of asking for a *receipt.*

A special form of certificate has been issued for this Convention and anybody neglecting to obtain it, properly made out and signed by the selling agent, will be compelled to pay full fare on the return trip.

Certificates are not kept at all stations. It is essential that special inquiry be made regarding this matter at least thirty minutes before departure of train.

If the agent at the station where the ticket is bought is not supplied with certificates, he will inform delegates at what station they can be bought. Buy a local ticket to the station designated and there take up a certificate and through ticket.

Upon arrival at Pittsburgh delegates should hand their certificates to the *Permanent Secretary* who will in turn hand them to the *Local Secretary* and special agent for endorsement. Even if certificates are properly made out and attested by the ticket agent at the selling office, they will not be honored for reduced fare on the return trip unless they are endorsed by the Local Secretary and validated by the special agent of the Railway Associations, and after being thus endorsed and validated they will not be honored for reduced rate on return trip unless they are deposited with the agents of terminal lines in Pittsburgh on or before July 9.

It has been arranged that a special agent of the Railway Associations will be in attendance to visé certificates on June 28, 29, 30, July 1, 2, and 3. A charge of twenty-five (25) cents for validating each ticket is made by the railways to defray cost of presence of special agent.

To prevent disappointment, it must be understood that the reduction on return journey is not guaranteed, but is contingent on an attendance of not less than 100 persons holding certificates obtained from the ticket agent at starting points showing payment of full first-class fare of not less than seventy-five (75) cents on going journey; provided, however, that if the tickets presented fall short of the required minimum and it shall appear that round trip tickets are held in lieu of certificates, they shall be reckoned in arriving at the minimum. This ruling regarding the minimum of 100 applies to the Western, Central, Trunk Line, and New England Passenger Associations. In each instance the return journey must be made by the same route traveled on the going journey, and it must be continuous.

If the necessary minimum is in attendance and certificates are properly made out and attested by the selling agent, acknowledged by the Local Secretary, validated by the special agent, and deposited with agents of terminal lines in Pittsburgh on or before July 9, holders of same will be entitled up to August 31 to a continuous passage ticket by the route over which going journey was made, at one third the first-class limited fare.

Extraordinary concessions have been made for this Convention by the above-named Passenger Associations in allowing the purchase of tickets for the going journey eight days prior to any of the scheduled meetings and extending this privilege up to and including June 30. For obvious reasons this concession has been slightly modified as above noted by the Western Passenger Association. The extension of time limit on the return tickets to August 31 is decidedly out of the ordinary. An exception of the usual rule requiring the return journey to be made at least three days after adjournment, was granted at the earnest request of the Chairman of the Local Committee, Dr. W. J. Holland, expressed through the Chairman of the Transportation Committee, Col. Samuel Moody, Assistant General Passenger Agent of the Penna. Lines West of Pittsburgh.

The *Southeastern Passenger Association* will sell tickets on the regular certificate plan conditions, namely: Certificates to be issued in connection with going ticket three days before (Sunday not included) and two days after the first day of meeting, and to be honored for return tickets up to and including third day of adjournment. This means that tickets will be sold on June 25, 26, and 27 and honored for the return journey from June 28 to July 6 inclusive. Instructions regarding purchase of tickets, obtaining certificates, and having certificates acknowledged and validated at Pittsburgh are the same as those given above for the other Passenger Associations with the exception, however, that no certificate will be honored for the return ticket unless presented during the time that the meeting is in session or within three days (Sunday not included) after adjournment.

The *Transcontinental Passenger Association* has not granted a special rate for this Convention, but suggests that delegates using their lines avail themselves of the privileges afforded by purchasing a nine-months' tourist ticket. This means transportation from extreme Western points to territory granting the rates above given, at two cents per mile, and is about equivalent to a rate of one fare and one third for the round trip.

The *Southwestern Passenger Association* has refused to grant any reduction of fare for this Convention.

George A. Wardlaw,
Local Secretary.

SCIENTIFIC NOTES AND NEWS.

The Senate of Dublin University has voted to confer the degree of Doctor of Science on Professor J. Willard Gibbs, of Yale University.

Dr. Carlos Finlay, of Havana, eminent for his work on yellow fever, has been given the degree of Doctor of Science by Jefferson Medical College, from which he graduated in 1855.

It appears from reports in the daily papers that American men of science—Dr. R. T. Hill, U. S. Geological Survey; Dr. Angelo Heilprin, Philadelphia Academy of Natural Sciences; Dr. T. A. Jagger, Harvard University, and Dr. E. O. Hovey, the American Museum of Natural History—have made careful observations of the geological conditions following the volcanic eruptions in the lesser Antilles.

President David Starr Jordan will leave on June 12 on the steamer *Sierra* for Samoa, where he will spend the summer in the investigation of the fishes and other marine animals of the Samoan islands. The work will be done for the United States Fish Commission, and Professor Vernon L. Kellogg, of Stanford University, will accompany Dr. Jordan.

Mr. J. S. Budgett, F.Z.S., Balfour student of the University of Cambridge, left England on May 22 for Uganda, via Mombasa, on a mission from the Zoological Society of London. He will proceed to the southeastern corner of the Protectorate, and take up a station on the Semliki River, where he will collect mammals and birds, study the fishes, and endeavor to investigate the habits of the okapi in the forest of Mboga. Mr. Budgett, who has already paid two visits to the Gambia, is a practiced collector of fishes and an experienced African traveller.

DR. LEOPOLD BATRES, conservator of national monuments, of Mexico, has returned from explorations of the ruins of Zapotecan cities in the State of Oaxaca.

DR. D. C. GILMAN, president of the Carnegie Institution, is at present in Germany, where he is holding consultations with the leading German men of science in regard to the plans of the institution.

THE bill to permit the retirement of Surgeon-General Sternberg with the rank of major-general was defeated by a vote of 68 to 103 in the House on June 2.

DR. WM. J. GIES, adjunct professor of physiological chemistry in Columbia University, has been appointed consulting chemist to the New York Botanical Garden.

PROFESSOR R. A. ZIMMERMANN has been appointed botanist to the Biological Station at Tanga in the German possessions in East Africa.

PROFESSOR LEWIS SWIFT, who is said to have discovered fifteen comets, has recently celebrated his eighty-first birthday.

DR. KARL NEUMANN, professor of mathematics at Leipzig, has celebrated his seventieth birthday.

DR. JOHN K. REES, professor of astronomy at Columbia University, will give the commencement address before the Worcester Polytechnic Institute, his subject being 'Recent Progress in Astronomy.'

AT the meeting of the Royal Geographical Society, on May 26, the following awards were made:—The Murchison grant for 1902 to J. Stanley Gardiner, for his researches in Funafuti Island, in the Pacific, and the Maldive Islands, in the Indian Ocean. The Gill memorial for 1902 to G. G. Chisholm, for the services rendered during 25 years to geographical education by text-books of various kinds, atlases and lectures, all of a high standard of value as well as for his geographical investigations, among other subjects into cataracts and waterfalls, and on the sites of towns. The Back grant for 1902 to Lieutenant Amdrup, for his two voyages of exploration to the east coast of Greenland, during which he surveyed and mapped in detail much of the coast hitherto unknown or imperfectly mapped. The Cuthbert Peek grant for 1902 to J. P. Thomson, who was founder of the Queensland branch of the Australian Geographical Society and by his writings and in other ways has done much to promote the interests of geography in Queensland.

PROFESSOR EMMETT S. GOFF, professor of horticulture at the University of Wisconsin, died on June 6 in Madison, after a short illness.

THE Rev. Dr. John Henry Barrows, president of Oberlin College, died on June 3, aged fifty-five years. Dr. Barrows was well known as an educator and author, and for the part he took in organizing the Parliament of Religions at the World's Columbian Exposition.

MR. W. H. AUSTIN, senior wrangler and Smith's prizeman at Cambridge and lecturer on mathematics at the University of Birmingham, died on May 20, at the age of twenty-seven years.

THE American Medical Association is this week holding its fifty-third annual meeting at Saratoga with about two thousand physicians in attendance.

THE American Institute of Electrical Engineers will hold its nineteenth annual meeting at Barrington, Mass., beginning on June 18.

THE American Electrochemical Society will hold its second general meeting at Niagara Falls, N. Y., beginning Monday, September 15.

THE position of computer in the Coast and Geodetic Survey at a salary of $1,000 will be filled by civil service examination on July 8 and 9. The position is open both to men and women.

THE New York City Board of Estimate has authorized the issue of $600,000 bonds, for the City College; $200,000 for the Museum of Natural History; $250,000 for new library sites, and $125,000 to begin the work of establishing public baths in Manhattan and Brooklyn.

Carl Faber, of Munich, a son of the late Johann Faber, the pencil manufacturer, has given 1,000,000 Marks for the Germanic Museum at Nuremberg and to the Bavarian National Museum at Munich.

Members of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Mining Engineers, and the American Institute of Electrical Engineers have united to found a gold medal in honor of the eightieth birthday of John Fritz, the eminent metallurgist. It is hoped that subscriptions of $10 amounting to five or six thousand dollars will be made.

There has been erected in Schenley Park, Pittsburgh, as gift of Mr. Phipps, a Hall of Botany. It adjoins the conservatory, being a substantial brick building equipped with laboratory facilities. The hall is for the study of botany by the school children of the city.

The Antwerp Geographical Society has opened an exhibition in the Zoological Park illustrating the recent progress of geological discovery.

In July next another German expedition will start from the West African coast for Lake Chad. This time it will have more of a scientific nature and will really be undertaken to study the products of the German territory up to the lake with a view of ascertaining the commercial value.

The British Board of Agriculture is informed by the High Commissioner for Canada that the Canadian Government has sent Mr. A. G. Hopkins, veterinary quarantine officer for Canada, to England to apply the tuberculin test to all cattle over six months old intended for export for breeding purposes from the United Kingdom to Canada.

The California Chapter of the Society of the Sigma Xi was organized this spring at the University of California. The total membership of the Chapter now number forty-nine, which includes the following students, recently elected from the scientific colleges: *Graduates:* E. Baruch, F. C. Calkins, R. T. Crawford, R. H. Curtiss, H. M. Hall, A. S. King, H. K. Palmer, and W. J. Sinclair. *Seniors:* A. Adler, J. S. Colbath, B. A. Etcheverry, C. O. Esterly, E. Everett, D. Finley, J. Newfield, G. C. Noble, C. P. Richmond and C. A. G. Weymouth.

Mr. W. Bruce, who is to lead the Scottish Antarctic expedition, has received a letter from Professor von Drygalski, leader of the German South Polar expedition, announcing the arrival of the *Gauss* at Kerguelen at the beginning of January. The expedition will therefore have made the ice at about the same time as the Swedish and British ships. Dr. von Drygalski has penetrated the Antarctic region at the point of the still hypothetical termination island in order to discover the western side of Victoria land and clear up its possible connection with the Kemp and Enderby lands. By taking this route he believes he may be ultimately able to sweep westwards by a high southern latitude into the South Atlantic and emerge by way of South Georgia.

The Berlin correspondent of the London *Times* writes under date May 25:—"Experiments were made last year at the General Telegraph Office in Berlin with the octoplex system of typographic telegraphy invented by the late Professor Henry A. Rowland, of Baltimore. The necessary apparatus for communication with Hamburg and Frankfort is being installed and will shortly come into use. It is claimed for the octoplex system that it enables a total of 20 officials at the despatching and receiving stations to send in one hour 18,000 words on a single wire. By the Hughes system at present in use between Berlin and the towns just mentioned it is not possible to send more than 2,200 words in the hour. The despatching instrument of the octoplex system resembles the Remington typewriter, and any given letter can be telegraphed by the depression of the proper key, whereas in other systems the depression of more than one key is usually necessary to form the current required to telegraph a letter. The labor of the despatching clerk is thus lightened, while at the same time the receiving instrument, by printing the message on a sheet of paper instead of on a tape, enables the attendant official to detach and forward the telegram as soon as it is concluded. If the system proves to be successful in practice, the result will be to relieve the congestion from which the wires now suffer, and thus to enable many places, which, owing to their distance from one another, have hitherto had to be content with an indirect service, to enjoy direct communication."

CONSUL G. W. ROOSEVELT, of Brussels, writes to the Department of State: In 1898, an international competition for a paste for matches not containing white sulphur was announced, and a prize of 50,000 francs was offered by the Belgian Government to the inventor. The commission appointed to judge results has now declared that, after four years of careful experiment and analysis, it has been found that none of the products so far submitted fill the required conditions, being defective in inflammability, igniting on all surfaces, or, in igniting, ejecting inflammable matter containing some poisonous substance. The sum already expended in the matter amounts to 8,178 francs. This covers cost of printing, correspondence with foreign countries, purchase of material, analysis and experiments.

WE learn from the London *Times* that an international agreement for the protection of birds useful to agriculture was concluded in Paris on March 19. The parties to the agreement are Belgium, France, Greece, Lichtenstein, Luxemburg, Monaco, Austria-Hungary, Portugal, Sweden, Switzerland and Spain. The agreement contains 16 clauses, of which the first states that birds useful to agriculture, especially insect eaters and birds enumerated in the lists attached to the agreement, are to enjoy an unconditional protection and that the destruction of these birds, their nests, eggs and broods is to be forbidden. Certain nocturnal birds of prey, as well as woodpeckers, bee-eaters, swallows, and several birds of the sparrow species, appear as useful birds, while ravens, magpies, jays and others are branded as mischievous. Some exceptions protect sporting and other rights. Italy, a country in which the capture of northward-bound birds is a regular trade, does not appear amongst the signatories. According to statistics recently given in the Reichstag no less than seven hundredweight of migratory birds were put on the Verona market at one time. The agreement will shortly be submitted to the Reichstag.

DURING the coming summer the United States Geological Survey will continue the study of the lead and zinc fields in northern Arkansas; this work will be under the charge of George I. Adams, assistant geologist, who will be assisted by Professor A. H. Purdee, of the Aransas State University, and by Ernest F. Burchard. In this investigation an attempt will be made to describe all the camps of that important section and in particular will include a careful survey of the territory covered by the Government topographic map sheet known as the Yellville quadrangle, which includes most of Marion and parts of Boone, Newton and Searcy counties. This work will be a continuation in detail of the study of the Ozark lead and zinc region, which includes northern Arkansas upon which a preliminary report by Baine and Adams was issued in the last annual. The results of the work will be a report on the lead and zinc field of northern Arkansas, together with a geological folio, which will follow other similar folios, issued by the Geological Survey, in giving an accurate geological description of the region, illustrated by maps showing the topography and also the surface, economic and structural geologic features. At the close of his work in northern Arkansas, Mr. Adams will be engaged in a reconnaissance in northern Texas for the purpose of determining the stratigraphic relations existing there between the Carboniferous and the so-called Red-beds; it is expected that this work will throw light upon the disputed problem of the extent of the Permian formation in that region. Mr. Adams has recently published a report on the oil and gas fields of the western interior and northern Texas Coal Measures, and the Upper Cretaceous and Tertiary of the western Gulf Coast, which appeared as Bulletin 184 of the United States

Geological Survey. A documentary edition of this bulletin for free distribution, upon application to the director, is now available.

UNIVERSITY AND EDUCATIONAL NEWS.

Bryn Mawr College has secured gifts amounting to $256,000, thus making available the conditional gift of $250,000 offered by Mr. John D. Rockefeller.

Friends of Columbia University have purchased from the New York Hospital for $1,900,000 the two blocks of land facing the University. It is hoped that this land may be ultimately acquired for the use of the University.

The valuable natural history collections, of the late Dr. C. Kramer, professor of botany at the Polytechnic Institute at Zurich, has been presented by his heirs to the institute.

Efforts are being made to establish a university at Frankfort on the Maine. The city possesses in its Schenkenberg Institute a school of natural science and medicine, and there is also in the city a commercial school. The trustees of the Karl Juegel's bequest, amounting to about $500,000, have decided to use the fund for a school of law, history and philosophy. The proposal now being considered is to unite these various institutions in a new university.

The University at Jena has established introductory courses in Greek and Latin for students from the Realgymnasia and Oberrealschulen who decide after coming to the University that they wish to study law.

The Omaha Medical College has recently become the medical department of the University of Nebraska. The first two years of the course will be given at both Omaha and Lincoln.

At the Jefferson Medical College, Philadelphia, Dr. Julius L. Salinger and Dr. Thomas G. Ashton have been elected professors of clinical medicine.

The School of Practical Agriculture, in which a number of New York citizens are interested and of which Professor George T. Powell is director, has purchased 415 acres of land for a site.

At Columbia University Professor Friedrich Hirth, of Munich, has been appointed head of the recently established Dean Lung Department of Chinese, and Dr. Felix Adler to a newly created professorship of social and political ethics. At the College of Physicians and Surgeons, the medical department of the University, Dr. Emmett Holt has been appointed clinical professor of the diseases of children, succeeding Dr. Abram Jacobi, who had held this position for more than thirty years and now becomes professor emeritus. Dr. Russell B. Opitz has been appointed demonstrator in physiology and Dr. R. E. Buffington, assistant in normal histology. Mr. J. H. Bair has been made assistant in the department of anthropology, and Miss Jean A. Brodhurst, assistant in botany at Barnard College.

Professor Lyman S. Morehouse, of Washington University, St. Louis, has accepted a chair of electrical engineering at the University of Michigan.

Mr. Arthur E. Wade, '02, of Cornell College, Iowa, has been appointed demonstrator in chemistry at the Sioux City Medical College.

Among the announcements made by President Goucher at the commencement of the Woman's College of Baltimore on June 3, were the following: Dr. Florence Peeble, instructor of biology, has been advanced to assistant professor. Miss Marie Eleanor Nast, Cincinnati, Ohio, who receives the fellowship given each year to a member of the graduating class, will study biology and physiology at the University of Chicago. Miss Nast last year received from the Woman's College a scholarship entitling her to study at the Marine Laboratory at Wood's Holl. Two Wood's Holl scholarships granted this year are awarded to Miss Mary Taylor Abercrombie, '03, Baltimore, Md., and to Miss Miriam Alice Belt, '03, Beltsville, Pa. A scholarship entitling the holder to work at Cold Spring Harbor is awarded to Miss Mary E. G. Lentz, Baltimore, Md.

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, JUNE 20, 1902.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*MEASUREMENT AND CALCULATION.**

IN my address of a year ago I sought, in a summary way, and by concrete illustration, to indicate how science originates in and advances with observation and experiment. I would now invite your attention to a similar consideration of the rôle which measurement and calculation play in the higher developments of science.

All sciences are at first qualitative. They pass in their growth from the fact-gathering stage of unrelated qualities to the orderly stage of related qualities and thence upward to the stage of quantitative correlation under theory. Such, at any rate, has been the course of all sciences hitherto developed, and it seems safe to predict that such will be the course of those which may arise in the future. The recognition of this fact is of prime importance. It helps us to understand the great relative diversity in perfection among the sciences; it affords a basis for rational optimism with respect to the continued progress of science; and it ought to make the specialists of the older sciences less contemptuous than they sometimes are in their attitude toward the newer ones which have not yet passed the 'rock-naming and bug-hunting stage.'

Whenever a quantitative relation be-

* Address of the retiring President of the New York Academy of Sciences, read February 24, 1902.

tween the factors of phenomena is observed, then measurements may be made in response to the question, What is the magnitude of the relation, if constant, or what are the extent and law of variation of the relation if it is not constant? When the law of relation is known, related quantities are subject to calculation, the measured values of some of them sufficing, through computation, to give the values of the others. All calculations, therefore, presuppose a knowledge of the laws of connection of related quantities, or quantitative theories of the phenomena considered.

Measurements and calculations are of all grades of definiteness, ranging from the smallest probabilities of the doctrine of chances up to the rigorous certainties of mathematical deduction. Thus the degree of precision attainable in the measured and computed quantities of a science is commonly taken as a gauge of its perfection. But it would be a mistake to infer complete perfection from the precision attainable in one or more branches of science. Astronomy, for example, is a marvelously perfect science in certain of its branches, but nevertheless some of its fundamental constants, notably the gravitation constant and the aberration constant, are known with only a low degree of precision.* Whether any quantity may be measured or calculated with precision depends, in general, on the degree of complication of its connections with other quantities, and on the applicability of methods already applied in the determination of other quantities. Frequently, a quantity may be measured directly; but it oftener happens, either by reason of the inapplicability or of the disadvantage of a direct method, that resort is had to an indirect method.

It is a remarkable fact, illustrating the essential unity which pervades the apparent diversity of nature, that all of the numerous quantities with which physical science has to deal may be expressed in terms of a certain very limited number of arbitrarily chosen quantities, or units. The units most commonly used, and those which seem best suited to the present requirements of science, are the units of length, mass and time. All other quantities, however complex, may be expressed readily in terms of these arbitrarily as-

* The gravitation constant is the factor by which the product of two masses divided by the square of their distance asunder must be multiplied in order to express the force exerted by those masses on one another. Thus, if m_1 and m_2 denote two masses, s their distance asunder, F the force of attraction between them, and k the gravitation constant, then

$$F=k\frac{m_1m_2}{s^2}.$$

It should be remarked that k is not a mere numeral, as many eminent writers on the law of gravitation would seem to imply, but that it is the cube of a distance divided by the product of a mass and the squares of a time; or that its dimensions are shown by the exponents in $(L^{+3}M^{-1}T^{-2})$ if L, M, T denote the units of length, mass and time respectively.

It should be remarked also that the above expression of Newton's law of gravitation lacks the precision essential for mathematical calculations. To make the statement definite and general m_1 and m_2 must be regarded as infinitesimals, so that the resultant attraction between two finite bodies requires, in general, a summation, or integration, for its exact expression. A widespread error exists in the notion that the above equation is exact if the distance s is the distance between the centers of gravity of the masses. This is true, indeed, for the class of bodies called centrobaric, like homogeneous spheres; but masses in general are not centrobaric.

The gravitation constant is, in C. G. S. units, about 667×10^{-12}, with some uncertainty in the last significant figure.

The aberration constant, which is (if it is nothing more than a kinematical quantity) the ratio of the velocity of the earth in its orbit to the velocity of light multiplied by the number of seconds in a radian, is about 20.5″ with some uncertainty in the next significant figure.

sumed fundamental quantities. It is by no means certain, however, that these units will best satisfy the requirements of science in the future. On the contrary, it seems rather probable that advancing knowledge will find some other system of units preferable, if it does not find several different though interconvertible, systems essential. We have, in fact, already attained two such diverse systems in the units of electro-magnetic science.

The study of such systems by the aid of the theory of dimensions, which shows algebraically how the assumed units enter into more complex quantities, is very instructive, not only to the mathematical physicist, but to the general student of physical science.* To illustrate this idea by some simple examples, it is well known that all quantities used in rational mechanics are commonly expressed in terms of length, mass and time. But these quantities might be expressed equally well, so far as algebraical statement is concerned, in many other ways. Thus, we might take energy as one of the fundamental quantities instead of either length, mass or time; in which case our mechanical quantities would be expressed in terms of energy, length and mass; or of energy, length and time; or of energy, mass and time. A consideration of these simple systems shows us, among other things, that rational mechanics might have been developed along lines of thought very different from the lines followed by our predecessors; and the fact that we do not visualize equally clearly all these systems shows that the experience of humanity with physical phenomena has been extremely limited. Most curious and instructive are the system in which length does not appear explicitly and the system in which time does not appear explicitly. May we not see in these systems opportunities respectively for the development of those individuals of our race who seem to possess no realization of distance or no conception of time?

Confining attention to the simpler and more familiar units of length, mass and time, and to a few of the more complex quantities expressed thereby, let us first consider briefly the present status of these fundamental units and the possibility of maintaining their invariability. The stand-

* Designating the units of energy, length, mass and time by E, L, M, T respectively, the dimensions of some of the most frequently used quantities in mechanics are shown in the following tables. In the first of these length, mass and time appear explicitly; in the second, length does not appear explicitly; and in the last, time does not appear explicitly. A glance at the exponents (dimensions) of the symbols shows clearly how definite the meanings of the terms force, energy, power, etc., may be in comparison with the utter ambiguity attaching to them in common parlance.

TABLE I.

Quantity.	Length Factor.	Mass Factor.	Time Factor.
Velocity,	L^{+1}	M^0	T^{-1}
Acceleration,	L^{+1}	M^0	T^{-2}
Force,	L^{+1}	M^{+1}	T^{-2}
Momentum,	L^{+1}	M^{+1}	T^{-1}
Energy,	L^{+2}	M^{+1}	T^{-2}
Power,	L^{+2}	M^{+1}	T^{-3}

TABLE II.

Quantity.	Energy Factor.	Mass Factor.	Time Factor.
Velocity,	$E^{+\frac{1}{2}}$	$M^{-\frac{1}{2}}$	T^0
Acceleration,	$E^{+\frac{1}{2}}$	$M^{-\frac{1}{2}}$	T^{-1}
Force,	$E^{+\frac{1}{2}}$	$M^{+\frac{1}{2}}$	T^{-1}
Momentum,	$E^{+\frac{1}{2}}$	$M^{+\frac{1}{2}}$	T^0
Energy,	E^{+1}	M^0	T^0
Power,	E^{+1}	M^0	T^{-1}

TABLE III.

Quantity.	Energy Factor.	Length Factor.	Mass Factor.
Velocity,	$E^{+\frac{1}{2}}$	L^0	$M^{-\frac{1}{2}}$
Acceleration,	E^{+1}	L^{-1}	M^{-1}
Force,	E^{+1}	L^{-1}	M^0
Momentum,	$E^{+\frac{1}{2}}$	L^0	$M^{+\frac{1}{2}}$
Energy,	E^{+1}	L^0	M^0
Power,	$E^{+\frac{3}{2}}$	L^{-1}	$M^{-\frac{1}{2}}$

ards of length and mass which are now universally adopted in science are the meter and the kilogram respectively, carefully intercompared copies, or 'prototypes,' of which have been distributed by the international bureau of standards to the nations contributing to the cost thereof. The United States possesses two copies of each of these prototypes, and they are, as a matter of fact, our effective working standards, even for the production of standard yards and pounds. It is to be hoped, therefore, that the end of the barbaric system of 'weights and measures' we have inherited from an unscientific ancestry is near at hand, and this not so much in the interest of men of science as in the interests of those less well fitted to struggle with the ingenious intricacies of the British system.

These prototype meters and kilograms are known in terms of the adopted standards, and hence in terms of one another, with a degree of precision which verges close to the limits of the constancy of matter itself. Thus the lengths of the meters are known with an uncertainty expressed by a probable error of only one part in five millions. This degree of refinement corresponds to about one hundredth of an inch in a mile, or to about nineteen miles in the mean distance of the earth from the sun. But this admirable precision is greatly surpassed by that of the kilograms, whose uncertainty falls to one part in five hundred millions. It is well known, of course, that the operation of weighing by means of the balance secures a precision superior to that of every other species of physical measurement; but it is not easy to visualize directly the five-hundred-millionth part of a kilogram. One may get a tolerably definite idea of this magnitude, however, by observing that with the degree of precision in question it would be essential in comparing two kilogram masses to keep the pans of the balance closely at the same level, for a centimeter difference in their altitudes would be appreciable by reason of the variation of the attraction of the earth with distance from its center.*

For present purposes, therefore, our standards of length and mass leave little, if anything, to be desired. But it is a matter of great importance to the future progress of science that these standards be preserved for an indefinitely long period; and although such a contingency seems remote enough now, one can hardly suppress the query as to what would happen to us if our standards should be lost, or if they should unexpectedly prove unstable with the lapse of time. It is quite certain that our standard of length could be recovered with a high degree of precision if such a calamity should befall us during the next ten thousand, or possibly during the next hundred thousand years. Numerous bars of other metals than the alloy used in the construction of the prototype meters are known in terms of the latter. Many base lines scattered at widely separated points of the earth's surface are also known in terms of the meter with a precision of about one part in a million; and although the foundations of the earth are far from stable, we can hardly expect such lines to become systematically shorter

* Denoting the mass of a kilogram by m_1 and the mass of the earth by m_2, the weight of m_1 by w, and the distance from the balance to the earth's center by s (since the earth is nearly centrobaric), the Newtonian law gives

$$w = k\frac{m_1 m_2}{s^2},$$

whence the relation of a small change Δw in w to the corresponding change Δs in s is expressed by

$$\frac{\Delta w}{w} = \mp 2\frac{\Delta s}{s}.$$

Since $\Delta w/w$ is here 1/500,000,000, and since s is about 630,000,000 centimeters, $\Delta s = \mp 0.63$ centimeter.

or longer in so brief a terrestrial interval as a million years. Better still, probably, is the check on the invariability of the meter afforded by Professor Michelson's measurement of it in terms of the wave lengths of particular rays emitted by the metal cadmium.* In this, apparently, we have a cosmic standard, although it remains to be proved that the wave lengths used will remain invariable in the unexplored parts of the universe into which we are journeying along with the solar system at the rate of some kilometers per second.

Our standard of mass is likewise connected directly with various masses which may serve as checks on its stability, and indirectly with the masses of definite volumes of many substances. It is especially well known in terms of the mass of a cubic decimeter of water at a standard temperature. It is less definitely known in terms of the atomic masses of the so-called elements, and it is roughly known in terms of the enormous though slowly varying mass of the earth.† But on the whole, our standard of mass must be regarded as less secure than our standard of length, although the prototype kilograms are less likely to change in mass with the lapse of time than the prototype meters are to change in length; for while such a general variation in volume as is known to occur in metals, especially alloys, need not affect the former, it would almost certainly affect the latter.

Our unit of time is also known with a definiteness that meets in most cases the highest demands of science at the present epoch. The period of rotation of the earth, or the sidereal day, is the standard interval of time, though it has been found convenient for many purposes to use the shorter interval of a mean solar second, of which there are 86,164.1 in a sidereal day. That the earth rotates with wonderful regularity is a fact of the highest importance to science. Without that regularity the development of sidereal and planetary astronomy, with all they have entailed, would have been impossible except by the discovery of some other equally trustworthy timekeeper. But the laws of mechanics, which show us plainly why the earth rotates with such remarkable regularity, also show us that its period of rotation is subject to sources of disturbance, some tending to increase and some tending to decrease that period, whose effects,

* See Tome XI., *Travaux et Mémoires du Bureau International des Poids et Mesures*, Paris, 1895. It is remarkable that the ratios of the three wave lengths used to the meter were measured with a precision requiring seven significant figures, the uncertainty amounting to a few units only in the last figure. Thus the values of the wave-lengths used (designated as red, green and blue respectively) are as follows, in microns, or millionths of a meter:

0.643,847,2,
0.508,582,4,
0.479,991,1.

† If we could measure the gravitation constant with a precision extending to five significant figures, the mass of the earth would at once become known to the same degree of precision, provided only that the law of gravitation is exact to the same number of figures. For I have shown that the product of that constant and the mean density of the earth is known with a precision expressed by five significant figures. Thus, calling the gravitation constant k and the mean density of the earth ρ,

$$k\rho = 36797 \times 10^{-11} / (\text{second})^2$$

This relation may be otherwise expressed by the following theorem: Let τ be the periodic time of an infinitesimal satellite which would revolve about the earth close to the equator (assuming no atmospheric resistance). Then the theorem asserts that

$$k\rho\tau^2 = 3\pi$$

where π is the ratio of the circumference to the diameter of a circle. The value of τ is 1 hour, 24 minutes, and 20.9 seconds. See *Astronomical Journal*, Vol. XVIII., No. 16.

though too minute to be appreciable in such intervals as are known to human history, must certainly become considerable in the course of terrestrial history. Thus, the contraction of the earth due to secular loss of heat tends to shorten the day, while accumulations of meteoric dust and tidal friction tend to lengthen it.* There exists also a graver source of disturbance in the slow rising and sinking of the crust of the earth in different latitudes so often pointed out by geologists. Such movements are only partly compensating in their effects on the day, and it seems highly probable that they may cause irregularities amounting to a few seconds in a century without entailing any noteworthy fluctuations of the relative positions of the land and sea.†

It appears, then, that our time unit is the least stable of the three fundamental units and hence the most in need of checks on its stability. Various other standards of time have been proposed, but none of them meets the requisites of permanency and availability. The interests of astronomical science especially demand that efforts be made to find in the solar system some better timekeeper than the earth. Possibly the fifth satellite of Jupiter may serve as a control on the constancy of rotation of the earth.

Turning now to a consideration of the more complex quantities which are expressed in terms of length, mass and time, we enter the boundless fields of physical science in which measurement and calculation have revealed to us all ranges of magnitudes from the vanishingly small to the indefinitely large. It is in these fields that we learn something definite concerning the limitations of our senses; for while measurements alone carry us but a little way along lines of research, calculation discloses not only the unseen, but also, in many cases, phenomena which are quite beyond the reach of any direct sense perception.*

To begin with quantities near the lower limit of determination, think, for a moment, what is going on in the air which for the present is the main medium of communication between us. No one has ever seen the particles of the atmosphere in the sense that we have all seen the particles, or corpuscles, of the blood. But we probably know more about the molecules of gases than we do about blood corpuscles. By actual count it is known that there are four to six millions of the latter in a cubic millimeter; and with equal definiteness calculation shows us that there are about a million million million molecules in a cubic

* I have discussed the effects of secular cooling and meteoric dust on the length of the day in a paper published in the *Astronomical Journal*, Vol. XXI., No. 22, July, 1901. From this paper it appears that the change in length of the day from secular cooling cannot be perceptible during any such brief interval as that of human history (twenty centuries, say); but that in the course of complete cooling, or in a million million years, say, the change in length of the day may amount to as much as six per cent. of its original length.

From the same paper it appears that accumulations of meteoric dust will only begin to be perceptible in their effects on the length of the day when the process of secular cooling has been substantially completed. In a subsequent number of the *Astronomical Journal* (Vol. XXII., No. 11), Dr. G. Johnstone Stoney has shown that if the compression produced by a layer of meteoric dust is taken into account the effect will be still less than that just indicated.

† See 'Mathematical and Physical Papers of Lord Kelvin,' Vol. III., pp. 333–335, Cambridge University Press, London, 1890.

* The reader may be referred to a very instructive paper by Dr. G. Johnstone Stoney entitled 'Survey of that Part of the Range of Nature's Operations which Man is Competent to Study.' *Scientific Proceedings of the Royal Dublin Society*, Vol. IX., No. 13; *Philosophical Magazine*, Fifth Series, No. 294, November, 1899; published also in *Report of Smithsonian Institution* for 1899.

millimeter of the air around us. Notwithstanding this apparently crowded assemblage, the individual molecules move about in the liveliest manner, their average speed being about five hundred meters per second, and this in spite of the fact that the average length of an unimpeded journey is barely visible by the aid of the best microscopes. Each molecule must therefore collide with its neighbors astonishingly often, the encounters occurring, in fact, about five thousand million times per second.*

More surprising still than the properties of assemblages of molecules forming gases are the properties of the individual molecules, especially when they are made up of two or more atoms. Such miniature systems, comparable, probably, in complexity with the Martian and Jovian subsystems of the solar system, exhibit degrees of constancy which rival the invariableness of the fixed stars themselves. This is particularly the case with their rates of vibration as disclosed by the spectroscope. These rates afford one of the most delicate tests of the properties of matter, whether it is found on the earth or on the most distant star; and yet the vibrations, which recur with a regularity equal to, if not surpassing, the regularity of the rotation of the earth, are executed at the rate of some hundreds of millions of millions per second.† Herein, perhaps, we may find a cosmic unit of time as well as a cosmic unit of distance, though both appear to be inconveniently small for terrestrial purposes.

But the smaller bodies of the universe do not end with molecules and atoms of gases. Recent investigations point to the conclusion that there is another order of bodies of much smaller dimensions and possessing still more wonderful properties. These have been called corpuscles.* Their density is only about one thousandth as great as that of the lightest gas, hydrogen; they are freely given off by several of the so-called radio-active substances; and they move about with speeds of the same order as the velocity of light. It appears not improbable that they play a most important rôle in cosmic as well as in terrestrial physics, and the amount of attention being given to them justifies the hope that their study may illuminate many obscure corners in the realm of molecular science.

Passing per saltum from the smallest measureable and calculable quantities to those with which we have an every-day familiarity, I would direct your attention to the great number of articles of commerce

* See, for example, 'The Kinetic Theory of Gases,' by Dr. Oskar Emil Meyer, translated by Robert E. Baynes, Longmans, Green and Co., New York, 1899.

† The number of vibrations per second corresponding to any given wave-length of light may be easily computed. For the velocity of light is about 300,000 kilometers, or 3×10^{14} microns per second, and this divided by the wave-length in question gives the number of vibrations per second. Thus the average wave-length of the cadmium rays used by Professor Michelson (cited above) is about half a micron. The material sources of these rays must vibrate, therefore, about six hundred million million times per second.

* See a paper by Professor J. J. Thomson, 'On Bodies Smaller than Atoms,' *Popular Science Monthly*, August, 1901.

See also a paper by Professor John Cox on 'Comets' Tails, the Corona and the Aurora Borealis,' *Popular Science Monthly*, January, 1902.

A fact of great interest in connection with the 'corpuscles' considered in these two papers is the repulsion of light impinging on bodies, the amount of which has been actually measured recently by several observers. This repulsion between the sun and the earth is very great, amounting to about a hundred million million dynes; but the gravitational attraction between these bodies is about forty million million times as great as that repulsion.

which are now weighed, measured and rated with precision and sold at a cost which, a half century ago, would have been thought quite impossible. Standard yards, meters, pounds and kilograms, and pocket time-pieces that will run within a few seconds per day, are available at prices within the reach of all who need them. Screws and screw gauges which will easily measure a hundredth of a millimeter (or four ten thousandths of an inch) are articles of trade; beautifully true spheres of steel or bronze may be had for a few cents each; helical springs of the finest steel and of remarkable uniformity are sold for a dollar a dozen; while articles like wire, tubing, sheet metal, and an indefinite variety of tools and machinery are made with a degree of perfection and at a cheapness of cost which would have been regarded as quite unattainable by the founders, for example, of the New York Academy of Sciences. The ready availability of, and the constant demand for, all these products to meet the daily needs of the complex civilization of our time affords a sufficient answer to him who would question the efforts spent in attaining those products or the efforts applied in subjecting new objects of study to the rigorous tests of measurement and calculation.

But the principles of measurement and calculation are not limited in their application to external objects, or to the properties of what we are sometimes pleased to call 'gross matter.' They apply equally aptly in many ways to man himself, and it is clear that with advancing civilization we may confidently expect such application to be greatly extended. While we have not yet attained formulas which will comprehend the vagaries of the individual, we have many formulas which will accurately express the resultant of those vagaries as manifested in racial types. A life insurance company, for example, may not assert at the beginning of a year that any individual of ten thousand men of the same class will die within the year, but it may assert with practical certainty that a definite number of this class will die within the year. Such 'facts and figures' are trite enough, of course, but what we commonly fail to see and appreciate is the solid basis on which they rest, and how greatly it would be to our advantage to extend the same sort of reasoning that has built up great systems of fire and life insurance into other departments of human affairs. Most people, I fear we must infer, are, like Thomas Carlyle, still scoffers at statistics, and few, even of the educated, have any adequate conception of the order which the principles of probability will bring out of the apparent disorder of statistical data.

Of the larger objects of the universe to which measurement and calculation have been applied with success, the earth easily surpasses all others in interest and importance. So great has been this success that one may assert that we know more of the earth than we do of any other body to which science has given attention. Its size, its shape, the amount and arrangement of its mass, its magnetic properties, its speeds of rotation and translation, its precession and nutation, and the lately discovered wabbling of its axis of rotation are all known with a definiteness which is truly surprising when one considers its magnitude and the degree of complexity of those properties. That the eight thousand miles in its diameter should be known within a few hundred feet, that the two hundred millions of square miles in its surface should be known within a few hundred square miles, or that the acceleration of gravity at any point on its surface should be known within a few millimeters per second per second, are results little short of marvelous when one reflects that they have all been attained within the brief interval of two hundred and fifty years. It would be quite wrong, however, to consider these achievements of geodesy as marvelous from the point of view of science. They are, rather, just such results as persistent scientific investigation has always produced, and such as we may safely predict will be uniformly produced by persistent scientific investigation in the future. The element of the marvelous comes in only when one takes account of the fact that these grand results were attained by a very small number of men, mostly members of academies, struggling, like our own, to maintain an existence, in whose work the general public took little interest, and whose names, even now, are much less known than the names of the obscure philosophers and the obscene poets of antiquity.

Geodesy is undoubtedly the most advanced of the sciences in which measurement and calculation have attained a high order of certainty. It has made modern commerce possible, and it seems destined to play a still more important rôle than it has hitherto in the advancement of terrestrial affairs. It has also made modern astronomy possible, for the certainty of its data enables us to measure not only the dimensions of the solar system, but also the approximate dimensions of the visible universe.

Not less important to the progress of science and to the general advance in human enlightenment are the achievements of the allied science of geology. It cannot boast, as yet, like geodesy, of a high degree of precision in measurement and calculation, for it deals, in general, with phenomena which have not yet been reduced to simple laws. But, on the other hand, its subject-matter is more obvious and tangible, and it appeals therefore more forcibly and continuously to the average mind. No science seems comparable with geology in the completeness with which its history and its main processes are contained in the subjects and objects of investigation. Whoso would read the story of the earth's crust will find it written and illustrated in infinite detail in the rocks themselves. No vivid or perfervid imagination of the historian has concealed the facts or misinterpreted their sequence; they are all recorded with a truthfulness that shames the straightest human testimony and with a permanency which permits comparison and verification in endless repetition.

Geology illustrates more clearly, perhaps, than any other science the value of measurement and calculation when the order only of the quantity sought can be attained. The determination of the fact, for example, that nothing short of a million years is a suitable time unit for measuring the age of the earth, was an achievement whose importance can hardly be overestimated; indeed, our race may yet require decades, if not centuries, to appreciate its full significance, for in spite of the great advances in our times it appears probable that not one in a thousand of the good people with whom we live realizes how profoundly definite acceptance of such a fact must modify thought.

A criticism which the devotees of the so-called humanistic learning often apply to such matters of fact, and which is still occasionally accepted by men of science, helps us to see the absolute need of countless recurrences to the evidence so well exhibited in the crust of the earth. "Ah!" says the humanist, "I observe that the physicists and the geologists do not agree on the age of the earth. Some say it is ten million years, others that it cannot be more than two hundred million years, and others that it cannot be less than a thousand million years. I conclude, therefore, that so long as your doctors disagree in this manner, we may continue to accept the age recorded in our sacred books." Thus easy is it to mistake the order of a quantity for the quantity itself.

When we pass from terrestrial limitations to celestial phenomena the field for measurement and calculation is immensely enlarged, though the results attainable are less easy of ready appreciation. The Jovian, the Saturnian and the Martian subsystems, which have been pretty thoroughly explored by the observer and the computer, present to us the type, apparently, not only of the solar system, but of the galaxy of systems within telescopic view. And the surveys of the heavens now in progress indicate likewise that isolated stars are the exception rather than the rule, and that the visible stars are generally attended by one or more satellites, which are probably oftener dark than bright bodies. Visual and photographic measurements have, in fact, united in recent years in the demonstration that the number of material bodies in the universe is enormously greater than we have hitherto imagined. Here again, however, as in the case of the geological phenomena just referred to, we must be content to a great extent for the present with a knowledge of the order of the quantities measured and calculated. But to be able to state what is the order of the distances which separate the fixed stars from one another, the order of the volume of the visible universe, the order of the quantity of mass in that volume, and the order of the time unit requisite for the expression of the historical succession of celestial events, seems little short of a stupendous contribution to knowledge when one reflects on the obstacles, material and intellectual, that have stood in the way of its attainment.

The distances asunder of the stars are so great that the hundred and ninety odd millions of miles in the diameter of the earth's orbit about the sun make an inconveniently small base line for the measurement of the least of those distances and a hopelessly inadequate one for the measurement of the greatest of them. It would appear more fitting, in fact, to express such distances indirectly in the number of years it takes light moving at the rate of 300,000 kilometers per second to traverse them. Assuming with Lord Kelvin that the visible universe is comprised within a sphere whose radius is equal to the distance of a star whose parallax is one thousandth of a second, this distance would require light about three thousand years to pass over it, while the average distance asunder of the visible stars is considerably less, but still of the same order. Lord Kelvin has shown also in a profound mathematico-physical investigation recently published* how we may assign limits to the amount of mass in the visible universe. It appears from this investigation that there are something like a thousand million masses of the magnitude of our sun within that universe. The figures for this amount of mass have little meaning to most of us when expressed in ordinary units. The mass of the earth, for example, with its $6{,}000 \times 10^{18}$ metric tons,† is a mere trifle, for the sun has about 327,000 times as much mass as the earth. The mass of the sun therefore is the obviously convenient unit in this case; and we have only to imagine our solar system surrounded by a thousand million such suns, each in all probability attended by a group of planets, to get a sufficiently clear idea of the quantity of mass within visual range of our relatively insignificant

* 'On Ether and Gravitational Matter through Infinite Space,' *Philosophical Magazine*, August, 1901. 'On the Clustering of Gravitational Matter in any Part of the Universe,' *Nature*, Vol. 64, No. 1669.

† The metric ton of 1,000 kilograms, or 2,205 pounds, is about the same as our 'long ton' of 2,240 pounds.

terrestrial abode. And the time scale for the varied events which take place in the interaction of these millions of suns is not less imposing when expressed in familiar terms. A million years is the smallest unit suitable for estimating the history of a star, although the record of that history is transmitted to us through the interstellar medium by vibrations whose period is so brief as to almost escape detection.

Measurements and calculations have thus made known to us a range of phenomena which is limited only by our sense perceptions, sharpened and supplemented by the refinements of mathematical analysis. In space and mass relations these phenomena exhibit all gradations from the indefinitely small to the indefinitely large; and in time they point backward to no epoch which may be called a beginning and forward to no epoch which may be called an end. Dealing chiefly with those aspects of phenomena which possess permanence and continuity, or at least a permanence and a continuity compared with which all human affairs appear ephemeral and fleeting, measurement and calculation tend to raise man above the level of his environment. They bid him look forward as well as backward, and they assure him that in a larger study of the universe lies boundless opportunity for his improvement.

But while that sort of knowledge which has been reduced to quantitative expression has done more, probably, than all else to disclose man's place in and his relations to the rest of the universe, it would appear that mankind makes relatively little use of this knowledge and that we are not yet ready, as a race, to replace the indefinite by the definite even wherein such substitution is clearly practicable. It is a curious and a puzzling, though perfectly obvious, fact that mankind as a whole lives less in the thought of the present than in the thought of the past, and that as a race we have far more respect for the myths of antiquity than we have for the certainties of exact science. Our ships, for example, are navigated with great success by aid of the sextant, the chronometer, and the nautical almanac; but what company would dare set Friday as the day for beginning the transatlantic voyage of a passenger steamer? From time immemorial tradition has dominated reason in the masses of men. Each age has lived, not in the full possession of the best thought available to it, but, rather, under the sway of the thought of some preceding age. We are assured even now, by some eminent minds, that the highest sources of light for us are nearly all found in the distant past; and a few go so far as to assert that modern science is merely furbishing up the half-lost learning of ages long gone by.

The work of academies and other scientific organizations is therefore nowhere near completion. Great strides toward intellectual emancipation have been made during recent times, but they have served only to enlarge the field for, and to increase the need of, that sort of knowledge which is permanent and verifiable. Measurement and calculation have furnished an invaluable fund of such knowledge during the two centuries just past, and we have every reason to anticipate that they will furnish a still more valuable contribution to such knowledge in the centuries to come.

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'NATURAL HISTORY,' 'ŒCOLOGY' OR 'ETHOLOGY'?

A STUDY of recent literature reveals the fact that zoologists are much in need of a satisfactory technical term for animal behavior and the related subjects which go to make up what is variously known as 'natural history,' 'œcology' and 'biology' in the restricted German sense. The need is also apparent in recent discussions in Science. As the number of workers in the field above indicated is rapidly increasing, any attempt to fix the terminology, if at all feasible, is certainly timely. In the opinion of the writer all the terms above mentioned are open to serious objection and should be avoided at least by zoologists who use the English language.

Most objectionable is the term 'natural history' on account of the number of its connotations. Not only may it be understood to include everything from mineralogy to anthropology and ethnology,* but even its more special meanings are most confusing. To convince ourselves of the truth of this statement we need go no further than the writings of Huxley. In his well-known essay 'On the Educational Value of the Natural History Sciences' (1854) and the 'Study of Biology' (1876) he uses the term as synonymous with 'biology.' After tracing the introduction of the word 'biology' to Lamarck and Treviranus† he says (p. 268): "That is the origin of the term 'biology' and that is how it has come about that all clear thinkers and lovers of consistent nomenclature have substituted for the old confusing name of 'natural history' which has conveyed so many meanings, the term 'biology.'" Nevertheless, in the introduction to his little classic on the crayfish (p. 4) he speaks of "that accurate, but necessarily incomplete and unmethodized knowledge which is understood by 'natural history.'" To this subject he devotes the opening chapter of the work above mentioned, and it is clear that he uses the term in one or both of two senses: first, to designate an historical or phyletic stage in the development of biological science, and second, as the name of a special discipline, which, though the oldest of all the biological disciplines, still survives and deserves to be cultivated. In view of this multiplicity of meanings, it would certainly be most expedient if we could restrict the term 'natural history' so that it would apply only to certain historical aspects of zoology and botany.

The origin and use of the term 'œcology' are well known. It was first introduced by Haeckel in his 'Generelle Morphologie' (1866, Vol. II., pp. 235, 236) as Professor Bessey has stated* and not as Dr. Bather supposes† in the 'Natürliche Schöpfungsgeschichte,' although a more expanded definition of the term occurs in the various editions of this work and in the 'Anthropogenie.' It should be noted that in the work just mentioned Haeckel distinguished accurately between 'œcology' and 'chorology,' including both, evidently as coordinate subjects under his third ('relational') subdivision of physiology.‡ The term 'œcology,' thus originally proposed by an eminent zoologist, has been adopted by the

* Conf., *e. g.*, Leunis' 'Naturgeschichte' and Woods' 'Natural History of Man.'

† Incidentally it may be remarked that the use of this term to cover both botany and zoology appears to be older than Huxley and other recent writers have supposed. According to Father E. Wasmann S.J. ('Biologie oder Ethologie?' *Biol. Centralbl.*, Bd. 21, No. 12, 1901, p. 392) who can write with authority on this question, the word was used by the schoolmen: "Aristotelian scholastics designated the study of living beings as 'biology.' The 'Biologia inferior' treated of organic human, animal and plant life; the 'Biologia superior' of the psychic life of man and animals," etc.

* Science, Vol. XV., No. 380, p. 593.

† Science, Vol. XV., No. 384, p. 748.

‡ Dr. Bather stigmatizes those who use the term 'chorology' as 'pedants,' overlooking the fact that we are not in the habit of applying this name to Haeckel and Huxley, both of whom must have found the word decidedly more concise and euphonious, and therefore better, than 'zoogeography,' 'phytogeography' or even 'geographical distribution.'

botanists, its spelling has been altered, apparently with no other gain than that of saving a letter, or rather part of a letter, and the meaning has often been modified till it is almost equivalent to 'chorology,' or at any rate 'chorological œcology.' And now the zoologists are reappropriating this term, modified spelling, meaning and all, in a manner which reminds one of the case of the good old German word 'Faltstuhl' (Eng. faldstool) which was boggled by the French to 'fauteuil' only to be again reappropriated, with much unction, in its unrecognized form by both English and Germans. It seems to the writer that it would certainly be expedient, not to say generous, for the zoologists to leave the botanists in undisputed possession of the term 'œcology,' especially as they seem to set some store by it. For, in the first place, the term was not a very happy one to begin with, no matter how we interpret the οἶκος part of the word. Haeckel intended it to mean something like the economy of nature ('die Lehre vom Naturhaushalte'), but one is at first inclined to understand it as referring merely to the habitat, or even to the dwelling or nest of an organism. This sense, in which it has been understood by Wasmann (*loc. cit.*, p. 392) and many other zoologists, not to mention botanists, is too narrow for the purpose we have in view, as will appear from the sequel.

Ever since the botanists adopted the word 'œcology' and applied it to the important subject which they are exploiting with such zeal and profit, there has been comment to the effect that the zoologists have been unduly neglecting a very promising province of their science. This certainly involves some misconceptions. The zoologists have perhaps distinguished somewhat more rigidly than their botanical brethren between 'chorology' and the proper province of 'œcology,' and in both of these subjects work worthy of the greatest admiration has been accomplished. If we confine our attention to zoological 'œcology' we find that it begins with Aristotle and Pliny, and a rapid survey of recent centuries shows that investigators like the following have devoted whole years of their lives to work in this field: Redi, Swammerdam, Roesel von Rosenhof, Réaumur, Bonnet, Buffon, Trembly, White of Selbourne, Erasmus and Charles Darwin, Wallace, Bates, Belt, Hudson, Romanes, Audubon, Wilson, Coues, Brehm, Houzeau, Leuckart, von Siebold, Semper, Steenstrup, Fritz Müller, Fabre, Francois and Pierre Huber, Giard, Plateau, Adler, Forel, Lord Avebury, Wasmann, Moggridge, McCook, Adlerz, Janet, Marchal, von Buttel-Reepen, Maeterlinck, Riley, Grassi, Lang, Dr. and Mrs. Peckham, Poulton, Silvestri, Erich Haase, Dahl, Escherich, etc. These are but few of the many whose works are scattered through the whole wide range of zoological literature. And there are undoubtedly many others who have investigated subjects like animal migration and the myriad problems suggested by whole groups of animals with which the writer has only a superficial acquaintance. That some botanists, and some zoologists, too, for that matter, have failed to appreciate the importance of the work accomplished by the above-mentioned 'œcologists' is easily explained. One observes that only a small minority of these investigators worked under university auspices. It is only too evident—and only too humiliating—that Schopenhauer's diatribes apply to the zoologists as well as to the metaphysicians, for the investigators above mentioned were '*amateurs*' in the true sense of the word, *i. e.*, lovers of animal life, and most of them therefore lived and worked untrammeled by the interminable 'Rücksichten' and 'Nachsichten' of university life. Here one is inclined, with Schopenhauer, to put a higher estimate on their investigations than on many of the publications of academic 'professionals,' especially as the work of the latter is coming to be more and more the expression of ephemeral laboratory fads, inflated with the intellectual infection so inseparable from 'schools' and 'tendencies' of all kinds.

The failure of zoologists to cultivate the province of their science corresponding to the 'œcology' of the botanists is more apparent than real for a second reason; viz., the great complexity of the zoological as compared with the botanical phenomena to be organized and methodized. And this leads us to a further reason for abandoning the term 'œcology' in zoology, and for suggesting the adoption of one essentially different. While botanists and zoologists alike are deeply interested in the same fundamental problem of adaptivity, they differ considerably in their attitude, owing to a difference in the scope of their respective subjects. The botanist is interested in the effects of the living and inorganic environment on organisms which are relatively simple in their responses. The zoologist, however, is more interested in the expressions of a centralized principle represented by the activity of the nervous system or some more general and obscure 'archæus' which regulates growth, regeneration and adaptation, carrying the type onward to a harmonious development of its parts and functions, often in apparent opposition to or violation of the environmental conditions. This finds its vaguest and most general expression in what we call 'character' or in what systematists feel, but are often unable to describe, the 'habitus.' Its deeper manifestations, however, are of the nature of instinct and intelligence. This language may be tinged with metaphysics, not to say mysticism, but those who have finally learned to find animals most interesting when not 'fixed' in some fluid recommended in a German laboratory, or converted into skins, skeletons, shells, cadavers or fossils, will comprehend at least the intention of the writer.*

The only term hitherto suggested which will adequately express the study of animals, with a view to elucidating their true character as expressed in their physical and psychical behavior towards their living and inorganic environment, is *ethology.* This term has been employed to some extent by French zoologists and, as the writer infers from Dr. Bather's article, attempts have already been made to establish its English usage. Dahl† has advocated its introduction into Germany in the place of 'Biologie' (in the German sense) a term which in that country has been very generally preferred to Haeckel's 'œkologie.' On the other hand, the retention of 'Biologie' has been ably defended by Wasmann (*loc. cit.*), and it is probable that it will remain in general favor, notwithstanding the ambiguity of the word. This danger is perhaps not so great in Germany, where every zoologist or botanist does not style himself a 'biologist' or at least give a course of lectures in 'general biology.' Be this as it may, however, the question is one to be settled by the Germans themselves, and we are at perfect liberty to use 'eth-

* The difference between the interests of the botanists and zoologists is most clearly seen in the difference of the problems suggested by 'plant societies' and by social animals.

† 1. 'Vergleichende Untersuchungen über die Lebensweise der Aasfresser,' *Sitz. Ber. Akad. Wiss. Berlin*, II., III., 16. Jan., 1896; 2. Experimentelle statistische Ethologie,' *Verhand. Deutsch. Zool. Gesel.*, 1898, pp. 121–131; 3. 'Was ist ein Experiment, was Statistik in der Ethologie?' *Biol. Centralbl.*, 21. Bd., 1901, p. 675.

ology,' especially as the German usage of 'biology' among English or American zoologists is almost without precedent.

The word 'ethology' is singularly happy in its derivation from ἦθος, which embraces in the wealth of its connotations, all the aspects of the zoological discipline for which a concise and appropriate name is so much needed. The origin of the word ἦθος from ἔθος, custom, usage, is clearly given in Aristotle.* The general Greek usage of ἦθος, especially in the plural ἤθη, as the accustomed seat, haunt, habitat or dwelling of men or animals, admirably expresses the chorological aspect of 'ethology'; its usage in the sense of habit, manners, etc. (Lat. *consuetudo, mores*) expresses what we mean by animal behavior, while the signification of ἦθος as character, disposition, nature, etc. (Lat. *indoles, ingenium, affectus*) is well suited to express the psychological aspects of 'ethology.' Certainly no term could be more applicable to a study which must deal very largely with instincts, and intelligence as well as with the 'habits' and 'habitus' of animals. It is apparent from a moment's reflection that the term may be readily made to include all and more than is meant by 'Biologie' in the German sense, or 'œcology' in the Haeckelian sense.

There may be a possible objection to the use of 'ethology' on the ground that it has been employed in English in two senses besides the one here advocated, viz., as the name of the science of ethics and as mimicry, or pantomime.† But the latter usage appears to be quite obsolete, and an authority on moral philosophy informs the writer that he has never encountered the word 'ethology' in the sense of 'ethics.' Hence this usage must be too uncommon to prevent the zoologist from appropriating the term for technical purposes.

Father Wasmann (*loc. cit.*, pp. 398, 399) defines 'ethology' (or rather its equivalent, 'Biologie') as 'the science of the external conditions of existence which pertain to organisms as individuals and at the same time regulate their relations to other organisms and to the inorganic environment.' It therefore embraces in its restricted sense: "first, a knowledge of the mode of life of animals and plants, their nourishment, dwelling, mode of propagation, the care of offspring and their development, in so far as these present external manifestations; hence also, second, a knowledge of the life-relations that obtain between individuals of the same and different species (including all the phenomena of parasitism, symbiosis, etc.), and hence also, third, a knowledge of the conditions of existence which are essential to the life and maintenance of animals and plants." It occurs to the writer that it would be better to substitute 'general' for 'external' in this definition. Of course, 'general and special' are open to the same objections as 'external and internal' on account of the impossibility of drawing a hard and fast line between the two alternatives. But it seems better, on the whole to emphasize the former alternatives on account of the large element of general comparative psychology, physiology, morphology and embryology, which must enter into ethological investigation. 'Generality' also expresses in a more satisfactory manner the central position of 'ethology' among the remaining zoological disciplines. Whenever we undertake the detailed or exhaustive study of an ethological problem we are led imperceptibly into the details of physiology, psychology, morphology, embryology, taxonomy or

* "*Τὸ γαρ ἦθος ἀπὸ τοῦ ἔθους ἔχει τὴν ἐπωνυμίαν. ἠθικὴ γὰρ καλεῖται διὰ του ἐθίζεσθαι.*" 'Ethica Magna,' II., 6.2; 'Ethica Eudemia,' II., 2.1. Ed. Bekker.

† Century Dictionary.

chorology, according to the particular aspect of the subject under consideration. On the other hand, the interests of all these various sciences are slowly but surely converging to a point which is not far from the center of gravity of 'ethology.' This is apparent in the 'types' and 'habitus' of the systematist and morphologist, in the conceptions of the 'individual,' in experimental embryology and the study of growth and regeneration, in the conceptions of 'adaptivity' among the 'neovitalists,' in the mystic zoology of a Maeterlinck, in the theories of 'determinate variations' and 'orthogenesis,' in recent experimental work on the origin of mutations, etc. In all this work there is apparent a turning away from the 'mechanical' and 'environmental,' a realization of the prematureness and inadequacy of all biological 'explanations' couched in terms of *existent* chemistry and physics, and an appreciation of greater depth and mystery in the life activities than had been previously conceded.

So numerous are the signs of the time that it requires little prophetic insight to discern that we are on the eve of a renascence in zoology. There have been voices crying in the wilderness for many years, and it may be well to hark back to some of these and catch the full force of their intention. First there was Goethe, who glowed with the magnificence of the problem:

"Was ist doch ein Lebendiges für ein köstliches, herrliches Ding! wie abgemessen zu seinem Zustande, wie wahr, wie seiend!"

Then there was the father of developmental science, Karl Ernst von Baer, who began to doubt whether the field he had himself cultivated with such success would yield more than a small portion of the desired harvest:

"Wissen möchten wir ob das 20. Jahrhundert nicht, wenn man die Kunst *das Leben im Leben* zu beobachten, wieder gelernt hat, über die Selbstzufriedenheit des 19. lächeln wird, mit der es glaubt, aus dem Leichnam das Leben in seiner ganzen Fülle erkennen zu können, fast vergessend, dass mit dem bildenden Leben ein handelndes innig verbunden ist, das dem Messer und dem Mikroskop sich entzieht."

And among the latest there is Jules Fabre, indefatigable observer and incomparable writer, who points to the old, sure method of all science as *the* method of 'ethology':

"Large part faite à l'anatomie, précieuse auxiliaire, que savons-nous de la bête? A peu près rein. Au lieu de gonfler avec ce rien d'abracadabrantes vessies, glanons des faits bien observés, si humbles soient."

William Morton Wheeler.

Austin, Texas,
May 17, 1902.

THE LAW OF VON BAER.

BASED ON SCHOLION V.

The writings of von Baer have been subject to much interpretation, and have yielded under the nursing hand of 'productive' scholarship, meanings which in reality they do not contain. It seems therefore worth while to reconsider what is the great generalization at which he arrived; and to those interested in the historical side of embryology, this attempt to follow the reasoning of a masterly investigator may be not unwelcome.

I.

THE PREVAILING VIEW THAT THE EMBRYO PASSES THROUGH THE ADULT STAGES OF LOWER ANIMALS.

At the time when the first volume of the 'Observations and Reflections on the Development of Animals' was published (1828), no propositions in embryology enjoyed wider acceptance than these: That higher animals in their development from the first beginnings correspond, stage for stage, with the adult condition of lower; that the development of the individual takes place according to the same laws as that of the series; that the more highly organized ones pass in general through the adult stages of those less highly organized, so that the differences between the stages in individual development, may be referred back to the differences between persisting adult forms.

These opinions, born of the time when, excepting Malpighi and Wolff, no one had studied connectedly the earlier periods in the history of the development of any animal, could not fail to excite interest; particularly since by their aid certain malformations could readily be explained as cases arrested in development. The rampant speculations of the Lamarckians derived support from them, but the teachings of this school were as repugnant to von Baer as to many other thoughtful students.

Suppose, he says, that a fish stranded on a sandy beach were seized with the desire to walk, then, according to this school, the fins, unsuited for the perambulatory movements, would promptly shrink in breadth from disuse and in turn grow in length. These modified appendages, transferred to children and grandchildren for several thousand generations, are naturally in the end transformed into feet. Naturally, too, the fish in the meadow gasp for air, and their struggles in the end produce lungs, the only requirement being that a few generations should be exposed to the slight inconvenience of not breathing at all.

The long neck of the heron is due to the fact that his ancestors often stretched that organ in order to catch fish. Their children came into the world with elongated necks and the same evil habit, and thus gave to their offspring necks still longer, from which it follows that if our planet only reaches a ripe old age, the heron's neck will extend beyond the bounds of certain knowledge.

II.

DOUBTS AND OBJECTIONS.

(*a*) At an early time von Baer saw that the relationships between different animals could not be looked upon as representing a steady advance, which is a necessary corollary of the propositions he has set out to criticise. Above all, suspicions were generated from the fact that until that time only the development of the higher forms was known, and this incompletely. What differences their embryonic history exhibited must, if they were to find analogies anywhere, find them among the lower animals. Indeed, resemblances between the embryonic condition of certain animals, and the adult stages of others, seemed to von Baer quite necessary and without significance, since they all fall within the realm of the animal kingdom, and the variations of which the animal body is capable are determined in each case by the interrelations of the separate organs, and in these interrelations, repetitions necessarily occur.

If birds had studied their own embryonic history, and were now engaged in unraveling the structure of adult mammals and man, would not their text-books read as follows:

Those four- and two-legged animals have similar embryos, for the bones of their skulls are separate and they have no bills, as we have after five or six days of incubation. Their extremities are all pretty much alike, about the same in length as our own; not a single true feather adorns their bodies, but only a thin down, in which respect our very nestlings surpass them. Their bones are not very brittle and contain (as ours do in youth) no air; indeed, they have no air sacs at all and their lungs are free in the pleural sacs; they are utterly devoid of a crop, and gizzard and stomach are but indistinctly delimited from one another, a condition ephemeral with us. The nails of most of them are clumsy and broad, as with us before hatching. Of all of them only the bats, which seem to be the most highly developed, possess the ability to fly. And these mammals, who for so long a time after birth are utterly helpless, and who during their whole lives can never raise themselves off the ground, claim to be more highly organized than we.

(*b*) If it were a law of nature that the development of an individual consists in passing through the adult stages of animals less highly developed, it would follow:

1. That no embryo could pass through stages which do not characterize the adult condition of some animal. There are no animals, however, which carry their food around in a yolk sac, and yet from the development of birds and certain mammals, such animals ought, according to the law, to exist.

2. Just as the environment of an embryo is related to the presence of organs which occur in no higher forms, so it makes impossible the passage through certain lower stages. Thus since all the higher embryos are bathed in water, that distinctive characteristic of insects, the tracheæ, can never develop.

3. An embryo, according to the prevailing theory, should resemble in its various stages a lower form, not merely in one particular, but in all. If at the time when the chambers of the heart are not yet separate, and the digits have not yet become distinct, the embryo is said to be in the fish stage, where is the flattened tail and all that makes up a fish and appears so early in its development?

4. There should be no ephemeral organs in lower animals which are permanent in higher ones, but there are many such, to some of which the bird embryologist has already called attention.

5. The organs in the different classes of animals should appear in the same condition in which we find them during the embryonic life of higher ones, but this is scarcely ever so.

6. Those structures found only in higher animals should appear late in their development. This, however, is by no means true. Parts of the vertebral column and the arches of the vertebræ appear in the chick earlier than any other organs. How can the chick ever resemble an invertebrate?

III.

THE RELATIONSHIPS BETWEEN DIFFERENT ADULT ANIMALS.

(*a*) The degree of development of the animal body, and the type of organization, must be clearly distinguished. The degree of development of the animal body consists in a certain amount of heterogeneity in its component parts; in diversity of tissues and of form. The more homogeneous the mass of the body, the lower the degree of development. The fishes, for example, because they have a brain, a cord and a skeleton, and present clearly the vertebrate type, are held to be superior to all invertebrates, and the advocates of the supposed law of development wonder that the bee and most insects with metamorphosis give evidence of greater skill and a more complicated life. In the bee, however, nerves and muscles are developed to such a degree that they differ from each other much more than do the same organs in fishes. Indeed the nerves and muscles of the latter seem to be soggy with the water in which they live.

(*b*) By type of organization is meant the relations existing between the organic elements and organs on account of their positions in space, and these spacial relations are connected with certain fundamental processes of life, viz., the position of the receptive and excretory poles. Type is thus entirely different and distinct from degrees of development. The same type may be exhibited in several different degrees of development, and conversely the same degree of development may be reached in several different types. The result of a degree of development and the type gives the distinguishing characteristics of a class.

THE DOCTRINE OF TYPES.

According to this doctrine, the animal world presents four fundamental types of organization, the peripheral or radiating type, found in infusorians, medusæ, and asteroids; the segmented or length type, found in worms; the massive type, found in molluscs, and in some radiolarians and infusorians; and finally the vertebrate type, a composite, in which all types are united. Thus the vertebrate brain is built probably after the asteroid type; the viscera are certainly molluscan, and the vertebral column, without doubt, worm-like, though according to the argument in other places, distinctively vertebrate at the same time.

These four fundamental types are capable, by suppression and expansion, of many combinations, and the amount of suppression or preponderance of the different types determines classes, genera, and species. 'If it be true,' von Baer says, 'that the larger and smaller groups of animals depend on this twofold relation, between the degrees of development and the types of organization, then the opinion that there exists an uninterrupted advance from the lower to the higher is based on misconception.'

IV.

APPLICATION OF THE ABOVE DOCTRINE TO THE HISTORY OF INDIVIDUAL DEVELOPMENT.

(*a*) It is clear that a higher or a lower degree of development is the same thing as a greater or less degree of diversity in tissues and in form. The mass out of which an embryo is molded, and the body mass of the simplest animal, are very much alike, for in both there is little distinctness of form, and slight contrast of parts. If therefore we discover in the tissues of some lower animals a greater degree of diversity than in others, and place them in series according to the differences presented, we find many coincidences between the observed facts and the requirements of the genetic law implied by this series.

(*b*) These coincidences between the facts and the theoretical requirements, however, do not show that the embryo of a higher form passes gradually through the adult stages of lower ones. It seems, in fact, as though the type of each animal were immediately impressed upon its embryo, and that this governs its whole development. The history of the chick is a commentary to this statement.

The first organs to be distinguished in the germ are those of the vertebrate type, and it is clear that after their appearance resemblance to an invertebrate can no longer be held. In the beginning of their development, all classes of vertebrates are very similar, and so we can say that the embryo of a vertebrate is from the beginning a vertebrate and has at no time any resemblance to an invertebrate. An adult animal, having the vertebrate type and such slight diversity of tissues and distinctness of form as the vertebrate embryo, is unknown, and so the embryos of vertebrates in their development do not pass through the adult stages of any known animals.

(*c*) 'Is there then no law of individual development?' asks von Baer. He believes there is and bases it on the following considerations:

The embryos of mammals, birds, lizards and snakes present such similarities in their entirety as well as in the development of corresponding parts that except for differences in size it would be difficult to distinguish them.

The further we go back in the history of development, the greater do we find those similarities, and only gradually do those special characters emerge from the general type which distinguishes the smaller groups of animals. To this the history of the chick in every stage of its development bears witness.

In the beginning, when the back closes, it is a vertebrate and nothing more. When the embryo becomes more and more separated from the yolk; when the gill clefts close and when the urinary sac grows out, it becomes a vertebrate unsuited for free life in the water. Only later, a difference in the extremities is recognizable and the bill appears; the lungs move upwards and the air sacs are established as rudiments. Now there is no longer any doubt that the form is a bird. While the avian characteristics become augmented by development of the wings and air sacs, and by the fusion of the carpel cartilages, the webs of the feet disappear and we have a terrestrial bird. Later when the crop is developed and the nasal scale appears, the terrestrial bird takes on the characters of the *Gallinæ* and finally those of the domestic fowl.

(*d*) Briefly, we may say that the point of greatest resemblance in the development of two animals is remote in proportion to the amount of difference they exhibit in their adult condition. The differences between the long-tailed and the short-tailed crabs are not very great. The crayfish has in the middle of its embryonic life a tail short in proportion to the broad sternum, and it is difficult to distinguish at this stage from the short-tailed crabs, which, according to Cavolini's figures, are in their embryonic condition comparatively long-tailed. The further we go back in the history of development, the greater do we find the similarity between the feet and the organs of mastication. We have thus not only an approach to the fundamental type, but a resemblance to the Stomatopoda, the *Amphipoda* and the *Isopoda*, which in their fully developed state differ more from the *Decapoda* than these do among themselves. To this may be added that in the *Decapoda* according to Rathke, the heart appears spindle-shaped, and many other points of similarity, so far unrecognized, must exist. Still earlier, when the feet are present as small laterally budding knobs, and the gills are not yet visible, a resemblance with true insects in their embryonic condition is not to be denied.

These considerations bring us to the question whether there is not, early in the history of development, a stage in which the embryos of vertebrates resemble those of invertebrates. In another place, von Baer shows that even the series of segmented animals begins development with a primitive streak, and that therefore during this brief period there is a resemblance between them and the early stages of vertebrates. In the germ, all embryos developed from a true egg probably resemble each other and in this lies a strong reason for considering the germ as the animal itself.

(*e*) The further back we go in development, the more points in common do we find in very different animals, and so the question arises whether in the beginning all are not fundamentally alike and whether there does not exist a common ancestor. All true eggs appear to have a distinct sheet-like germ, which seems to be lacking to the germ grains so far as their development is known. These latter are in the beginning solid, but their first act of independent life seems to be a hollowing-out by which they become converted into thick-walled vesicles, observed in the case of *Cercaria* and *Bucephalus*. The germ of a true egg is also to be looked upon as a vesicle, which in the case of birds only gradually grows around the yolk, being supplemented in the beginning by the vitelline membrane. Since, however, the germ is the undeveloped animal itself, we cannot assert, without good reason, that the simple vesicular form is the common ancestor from which all animals are descended. The germ grain goes over into this primitive condition on account of its own inherent power; the egg, only after its female nature has been neutralized by fertilization. Not until this has occurred does the separation into germ and yolk, or body and nutrient stuff, take place.

(*f*) If in order to find resemblance between two animals, we must go back in the history of development a distance proportional to the amount of difference they display in their adult condition, we must recognize as laws of individual development:

1. That those characteristics common to a large group of animals appear earlier in their development than those which characterize the members of the group individually.

2. That from the general, the less general is formed, until what is most special appears.

3. That the embryo of every animal, instead of passing through the adult stages of others lower in the scale, in reality grows increasingly different from these.

4. That the embryo of a higher animal never does resemble the adult of a lower one, but only its embryo.

It is only because the less highly developed animals go little beyond their embryonic condition, that they present certain points of similarity with the embryos of higher forms. These resemblances therefore do not indicate the existence of a limiting condition determining the course of the development of the higher forms, but find their explanation in the organization of the lower ones.

(*g*) These facts are illustrated graphically in a table showing the advance from the lowest grade of development to the highest. From this schema it is clear that an embryo cannot be maintained to pass in its development through the whole series of animals, because it cannot pass from one fundamental type over into another. Then again an embryo in its development does not pass through another form but only through the region of indifference between that form and its own adult condition. Thus the further the development proceeds, the narrower does the region of indifference become. The *schema* also demonstrates that an embryo in the beginning is an indifferent vertebrate, then an indifferent bird, and so on. Since in its progression from one region of indifference to the next it is becoming internally more and more perfect, it is at the same time also becoming a more and more highly developed animal.

The view here advocated differs from the one generally held, in that this is based on an unproved assumption and derives support from the neglect of the important distinction between type of organization and degree of development.

The embryo is gradually formed by progressive diversification of tissues and of form, and for this reason the younger it is, the more nearly does it resemble slightly developed animals. Different animals vary more or less from the basal type which is nowhere pure but occurs only in definite modifications. Fishes are nearer the type than mammals and especially man. Naturally therefore the embryos of mammals resemble fishes. If we recognize in the fish merely the slightly developed vertebrate (which is the unfounded assumption) we must interpret the mammal as a highly developed fish, and then of course it is consistent to say that the embryo of a vertebrate is at first a fish. For this reason the prevailing view of the law of individual development necessarily implies a progressive series in the animal kingdom. But the fish is more than an imperfect vertebrate. It has undoubted piscan characters as its development abundantly shows, and this development, as in all animals, is governed by two conditions:

1. By progressive diversification of tissues and of form, accompanied,

2. By the passage from a general, indifferent and indefinite state into a definite and particular one.

Otto C. Glaser.

Johns Hopkins University.

MEMBERSHIP OF THE AMERICAN ASSOCIATION.

The following have completed their membership in the American Association for the Advancement of Science during the month of May:

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SCIENTIFIC BOOKS.

La géometrie Non-Euclidienne. Par P. Barbarin. Paris, C. Naud. Scientia, Février. 1902. Phys. Mathématique, No. 15. Pp. 79.

It is peculiarly appropriate that from Bordeaux, made sacred for non-Euclidean geometry by Hoüel, should emanate this beautiful little treatise, decorated with a 'gravure' reproducing part of a manuscript of Euclid, also with the official portrait of Lobachevski, but best of all, with a portrait of Riemann.

It begins from the hackneyed position: 'Experience therefore it is which has furnished to the ancient geometers a certain number of primitive notions, of axioms, or fundamental postulates put by them at the basis of the science.' But now we know there never was any pure receptivity. In all thinking enters a creative element. Every bit of experience is in part created by the subject said to receive it, but really in great part making it.

Professor Barbarin continues: 'From the epoch of Euclid, this number has been reduced to the strict minimum necessary, and all the others not comprised in this list, being capable of demonstration, are put in the class of theorems.' Now we know that Euclid omits to notice many of the assumptions he unconsciously employs, for example all the 'betweenness assumptions,' while Hilbert has at last rigorously demonstrated Euclid's assumption 'All right angles are equal,' and in turn one of Hilbert's assumptions has just been proved (see *Amer. Math. Monthly,* April, 1902, pp. 98–101).

The 'Elements' of Euclid, says Professor Barbarin, enjoyed throughout all the middle ages and still enjoy a celebrity that no other work of science has attained; this celebrity is due to their logical perfection, to the admirable concatenation of the propositions, and to the rigor of the demonstrations. 'Il mit dans son livre,' says Montucla, 'cet enchaînement si admiré par les amateurs de la rigueur géométrique.' "In vain," he adds, "divers geometers whom this arrangement has displeased, have attempted to better it.

"Their vain efforts have made clear how difficult it is to substitute for the chain made by the Greek geometer another as firm and as solid."

'This opinion of the historian of mathematics,' says our author, 'retains all its value even after the researches which geometers have undertaken for about a century to submit the fundamenal principles of the science to an acute and profound examination.' I add that the remarkable discoveries of Dehn (see SCIENCE, N. S., Vol. XIV., pp. 711–712) prove an unexpected superiority for Euclid over all successors down to our very day, and suggest the latest advance, which, though as yet unpublished, exists, for under date of April 2, 1902, Hilbert writes me: 'In einer andern Arbeit will ich die Lobatschefski'sche Geometrie in der ebene unabhangig von Archimedes begrunden.' That is, Hilbert will found Bolyai's geometry as he has Euclid's, without any continuity assumption.

To get the benefit of this brilliant achievement, I am holding back my own book on this fascinating subject.

Says Hilbert in his unpublished Vorlesung ueber Euklidische Geometrie, "The order of propositions is important. Mine differs strongly from that usual in text-books of elementary geometry; on the other hand, it greatly agrees with Euclid's order.

"So fuehren uns diese ganz modernen Untersuchungen dazu, den Scharfsinn dieses alten Mathematikers recht zu wuerdigen und aufs hoechst zu bewundern."

Again, *à propos* of Euclid's renowned parallel postulate, Hilbert says: "What sagacity, what penetration the setting up of this axiom required we best recognize if we look at the history of the axiom of parallels. As to Euclid hmself (circa 300 B. C.) he, *e. g.*, proves the theorem of the exterior angle before introducing the parallel axiom, a sign how deeply he had penetrated *in den Zusammenhang der geometrischen Saetze.*"

Professor Barbarin repeats the exploded error of attributing to Gauss the discovery of the non-Euclidean geometry in 1792. In the introduction to my translation of Bolyai's 'Science Absolute of Space,' pp. viii–ix, is a letter from Gauss, on which I there remark: "From this letter we clearly see that in 1799 Gauss was still trying to prove that Euclid's is the only non-contradictory system of geometry, and that it is the system regnant in the external space of our physical experience. The first is false; the second can never be proven."

In 1804 Gauss writes that in vain he still seeks the unloosing of this Gordian knot.

Again, with the date April 27, 1813, we read: "In the theory of parallels we are even now not farther than Euclid was. This is the 'partie honteuse' (shameful part) of mathematics, which soon or late must receive a wholly different form." Thus in 1813 there is in Göttingen still no light.

But in 1812 in Charkow, the non-Euclidean geometry already had been for the first time consciously created by Schweikart, whose summary characterization of it is given in SCIENCE, N. S., Vol. XII., pp. 842–846. This he communicated to Bessel and sent to Gerling and afterward to Gauss in 1818, so that it may claim to be the first *published* (not printed) treatise on non-Euclidean geometry.

By this time Gauss had progressed far enough to be willing to signify *privately* his acceptance of Schweikart's doctrines.

On p. 15, Barbarin makes a brief argument for Euclid's axiom, 'All right angles are equal.'

This argument was good before Hilbert and Veronese, since this axiom can never be proved by superposition. It is already a consequence of the assumptions preliminary to motion. This profounder analysis Barbarin has not attained to. He still uses as a postulate and supposes indispensable 'l'indeformabilité des figures en déplacement.' What Jules Andrade calls 'cette malheureuse et illogique définition' of Legendre, 'the shortest path between two points is a straight line,' Barbarin puts as an elementary proposition!

Manning also, p. 2, assumes it, thus invalidating and making ephemeral his pretty little 'Non-Euclidean Geometry' (Ginn & Co., 1901). Barbarin then proceeds to classify geometries by Saccheri's three hypotheses, the hypothesis of obtuse angle, the hypothesis of right angle, the hypothesis of acute angle, or that the angle sum of a rectilinear triangle is greater than, equal to, less than two right angles.

But the remarkable discoveries of Dehn have now shown that this classification is invalid.

Barbarin says, p. 16, 'Saccheri proves that the hypothesis of the obtuse angle is incompatible with postulate 6' of Euclid.

Dehn dissipates this supposed incompatibility by actually exhibiting a new geometry in which they amicably blend, which he calls the non-Legendrean geometry.

In the same way, the hypothesis of right angle amalgamates with the contradiction of Euclid's parallel-postulate in a geometry which Dehn calls semi-Euclidean. As Dehn states this result: There are non-Archimedian geometries in which the parallel-axiom is not valid and yet the angle-sum in every triangle is equal to two right angles. Thus the theorem (Legendre, 12th Ed., I., 23; Barbarin, p. 25): 'If the sum of the angles of every triangle is equal to two right angles the fifth postulate is true,' is seen to break down.

Manning's 'Non-Euclidean Geometry,' though it says (p. 93), 'The elliptic geometry was left to be discovered by Riemann,' gives only the single elliptic.

It never even mentions the double elliptic, or spherical or Riemannian geometry, which Killing maintains was the only form which ever came before Riemann's mind. If so, then Barbarin's book is like Riemann's mind. The Riemannian, as distinguished from the single elliptic, is the only form which appears in it. Killing was the first who (1879, *Crelle's Journal*, Bd. 83) made clear the difference between the Riemannian and the single elliptic space (or as he calls it, the polar form of the Riemannian).

Klein championed the single elliptic. Manning knows no other.

Professor Simon Newcomb, like Manning, deals only with the single elliptic in his treatise: 'Elementary theorems, relating to the geometry of a space of three dimensions and of uniform positive curvature *in the fourth dimension.*'

The last four words F. S. Woods replaces by seven dots in his article 'Space of constant curvature' (*Annals of Math.*, Vol. 3, p. 72), though blaming Professor E. S. Crawley for the error they contain.

Newcomb's also was the unfortunate conceit which dubbed this 'A Fairy-tale of Geometry,' a point of view from which he is still suffering in his latest little unburdening in *Harper's Magazine.*

Just so Lobachevski had the misfortune to call his creation 'Imaginary Geometry.' Contrast John Bolyai's 'The Science Absolute of Space.'

In single elliptic space every complete straight line is of finite constant length πk.

Every pair of straight lines intersect and return again to their point of intersection, but have no other point in common.

In the so-called spherical space, that is the Riemannian space, two straight lines always meet in two points (opposites, or antipodal points) which are πk from each other.

The single elliptic makes the plane a unilateral or double surface, so that two antipodal points would correspond to one point, but to opposite sides of this one-sided plane with reference to surrounding three-dimensional elliptic space.

The geometry for two-dimensional Riemannian space coincides completely with pure spherics, that is with spherics established from postulates which make no reference to anything off of the sphere, inside or outside the sphere. Hence the great desirability of a treatise on pure spherics. It would at the same time be true and available for Euclidean and for Riemannian geometry.

Yet its relations to three-dimensional Euclidean and three-dimensional Riemannian space would differ radically.

Through every Riemannian straight line

passes an infinity of planes also Riemannian, and in each of these this straight has a determined and distinct center; but the straight is independent of the planes, and is defined by the postulates.

Now in the sphere the great circle and the one *pseudo*-plane which contains and fixes it, namely the sphere, are inseparable, since any portion, however minute, of either determines all the other as well as its center and radius.

In the single elliptic geometry the elliptic straight line does not divide the elliptic plane into two separated regions. We can pass from any one point of the plane to any other point without crossing a given straight in it. Starting from the point or intersection of two straights and passing along one of them a certain finite length, we come to the intersection point again without having crossed the other straight. Hence we can pass from what seems one side of the straight line to what seems the other without crossing it, that is, it is uni-lateral or double.

This single elliptic geometry is never mentioned in Barbarin's book; just as the Riemannian is never mentioned in Manning's book. First take your choice, then buy your non-Euclidean geometry.

On p. 36, Barbarin gives to Gauss the honor which belongs to Wallis of being the first to remark that the existence of unequal similar figures is equivalent, in continuous space, to the parallel postulate.

In Chapter VII., 'Les Contradicteurs de la géométrie non-euclidienne,' Professor Barbarin makes with unanswerable vigor the argument which I gave in my 'Report on Progress in Non-Euclidean Geometry' (SCIENCE, N. S., Vol. X., pp. 545–557).

There I quoted Whitehead who was the first to publish (March 10, 1898) "the extension of Bolyai's theorem by investigating the properties of the general class of surfaces in any non-Euclidean space, elliptic or hyperbolic, which are such that their geodesic geometry is that of straight lines in a Euclidean plane.

"Such surfaces are proved to be real in elliptic as well as in hyperbolic space, and their general equations are found for the case when they are surfaces of revolution.

"In hyperbolic space, Bolyai's limit-surfaces are shown to be a particular case of such surfaces of revolution.

"The same principles would enable the problem to be solved of the discovery in any kind of space of surfaces with their 'geodesic' geometry identical with that of planes in any other kind of space."

Now not only the strikingly important problem solved by Whitehead, but also the analogous problem indicated had both been solved by Barbarin and presented three months before to the Académie Royale de Belgique; but these investigations were only published after the appearance of my Report (October 20, 1899). They, as Barbarin says, p. 63, 'bring out in a striking manner the absolute independence of the three systems of geometry, which are able each to get everything from its own resources without need of borrowing anything from the others.' In each of the three spaces, Euclidean, Bolyaian, Riemannian, there exist surfaces whose geodesics have the metric properties of the straights of the two other spaces.

But the book in which these beautiful researches are published: 'Etudes de géométrie analytique non euclidienne par P. Barbarin, Bruxelles,' 1900, Hayez, pp. 168, has other titles to universal recognition.

Notwithstanding the ever-present example of Euclid, who never uses a construction or a figure which he has not shown to follow deductively from his two postulated figures, the straight and the circle, an insidious error crept into geometry, taught by Beman and Smith, who should know better, in the following words: (See their 'Geometry,' 1899, p. 70, § 112) "*Note on Assumed Constructions.*— It has been assumed that all constructions were made as required for the theorems.

"Thus an equilateral triangle has been frequently mentioned, although the method of constructing one has not yet been indicated, a regular heptagon has been mentioned, and reference might be made to certain results following from the trisection of an angle, although the solutions of the problems, to construct a regular heptagon, and to trisect any angle, are impossible by elementary geometry. But the possibility of solving such problems has nothing to do with the logical sequence of the theorems." This is a fundamental blunder.

The construction so glibly assumed, to pass a circle through any three non-co-straight points, is equivalent to the assumption of the world-renowned parallel postulate, and thus has everything in the world to do with the sequence of the theorems. The assumed construction of a triangular from three sects which are to be its sides, by the method of Beman and Smith, p. 76, is equivalent to the assumption of the Archimedes postulate, which again has everything to do with the logical sequence of the theorems. In fact just this assumption makes ephemeral the beautiful method of Saccheri used in the book we are reviewing.

Hence we can appreciate that astounding achievement of Bolyai's young genius, his § 34, where he solves for his universe, Eu., I., 31. To draw a straight line through a given point parallel to a given straight line. His brilliant lead was followed more than half a century later by Gerard, but it is Barbarin who has ended the matter by deducing from certain very simple constructions of the trirectangular quadrilateral all the fundamental plane constructions.

In Chapter VIII. (La géometrie physique,' § 30 'La forme géometrique de notre univers') our author stresses the idea, that even if our universe were exactly Euclidean, it would be forever impossible for us to demonstrate this. As I said in my 'Non-Euclidean Geometry for Teachers,' p. 14, "If in the mechanics of the world independent of man we were absolutely certain that all therein is Euclidean and only Euclidean, then Darwinism would be disproved by the reductio ad absurdum. All our measurements are finite and approximate only. The mechanics of actual bodies in what Cayley called the external space of our experience, might conceivably be shown by merely approximate measurements to be non-Euclidean, just as a body might be shown to weigh more than two grams or less than two grams, though it never could be shown to weigh precisely, absolutely two grams."

Our author suggests the following experiment for proving our space non-Euclidean: From a point trace six rays sixty degrees apart. On them successively mark off the sects OA_0, OA_1, OA_2, $\cdots$, OA_n, of which each is the projection of the following. If we finish by finding between OA_n and $2^n OA_0$ a difference of constant sense and greater than imputable to error of procedure, our universe is non-Euclidean.

In conclusion this beautiful little book has the advantage of being the production of an active and fertile original worker in the domain of which it treats. His 'Géométrie général des espaces' (1898), his 'Sur le paramètre de l'univers' and 'Sur la géométrie des êtres plans' (1901), 'Le cinquième livre de la métagéometrie,' (1901), 'Les cosegments et les volumes en géométrie non euclidienne' (1902), and his 'Poligones réguliers sphériques et non-euclidiens,' shortly to appear in that virile young monthly *Le Matematiche,* and which I had the advantage of reading in manuscript, show that Bordeaux is honored by a worthy successor of Hoüel, so universally beloved.

George Bruce Halsted.

Austin, Texas.

Lamarck, The Founder of Evolution, His Life and Work, with Translations of His Writings on Organic Evolution. By Alpheus S. Packard, M.D., LL.D. New York, London and Bombay, Longmans, Green & Co. 1901. Pp. xii+451.

This appears to the reviewer to be a noteworthy book; he has read it from cover to cover with so much pleasure that he ventures to predict that it will prove a source of satisfaction to that large body of readers who are interested in the rise of evolutionary thought.

Larmarck lived in advance of his age and died comparatively unappreciated.

Although quiet and uneventful, his life was a busy one, and, as sketched by Dr. Packard, his noble character, his generous disposition and his deep intellectuality are well brought out.

His devoted and loyal daughter, Cornelie, without whose assistance his later works could not have been prepared, encouraged her father in the days of his blindness and neglect, by saying 'La postérité vous honorera.' And this has come true. Lamarck, who struggled with poverty and other depressing conditions, whose views were laughed to scorn by Cuvier, and neglected by the intellectual leaders of his time, is now receiving honor and recognition. His original and philosophical mind dealt with some of the burning questions of our day, and he is now placed above Cuvier as a thinker, and heralded, by many, as the most colossal figure in the history of the philosophy of organic nature, between Aristotle and Darwin. This fresh interest in Lamarck's views makes Dr. Packard's book especially timely.

A number of new biographical facts are added to the few that have been generally known, and the book is illustrated with four portraits of Lamarck, pictures of his birthplace, the house in which he lived in Paris, etc. In reference to the analysis of his writings the author says: 'As regards the account of Lamarck's speculative and theoretical views, I have, so far as possible, preferred, by abstracts and translations, to let him tell his own story, rather than to comment at much length myself on points about which the ablest thinkers and students differ so much.' This part of the author's task has been especially well done. Nowhere else can one find in a single volume such a comprehensive survey of Lamarck's theoretical writings.

The growth and essential features of his theory of organic evolution are shown by ample quotations. This theory was unfolded in 1800 and fully expounded in 1809 in the well-known 'Philosophie Zoologique.' The various expressions of his views in 1800, 1802, 1803 and 1806, as leading up to the latter work, are well illustrated, and seventy-six pages are devoted to quotations from the 'Philosophie Zoologique.'

Several current misconceptions are corrected, as for example—the earliest expression of Lamarck's views, as far as his published writings show, was in 1800, in the introductory lecture to his course on the invertebrates, not, as commonly believed, in his 'Recherches sur l'Organisation des Corps Vivans,' published in 1802. Incidentally, also, in reference to Buffon, it is shown that his opinions on the variability of species were not separated into three periods, but that from the time he began to express his views on that matter, to the end of his life, he was an advocate of the mutability of species.

Lamarck's work is treated from all sides; in addition to the exposition of his views on organic evolution, there are chapters on his work in botany, geology, invertebrate paleontology, general physiology and biology, zoology, his thoughts on morals and on the relation of science and religion, and on the relation of his evolutionary views to those of Buffon, St. Hilaire and Erasmus Darwin. There is also a fine chapter on Neolamarckism.

Thoroughness and breadth are notable features in this account of Lamarck and his life work.

WILLIAM A. LOCY.

SOCIETIES AND ACADEMIES.

EIGHTH REGULAR MEETING OF THE BOTANICAL SOCIETY OF WASHINGTON.

THE eighth regular meeting of the Botanical Society of Washington was held at the Portner Hotel, May 24, 1902, with President A. F. Woods in the chair. At the conclusion of the business meeting, Dr. B. M. Duggar, chairman of program for the evening, was called upon to preside.

Mr. E. L. Morris called attention to specimens of *Trillium* found near Great Falls of the Potomac River which produced long-petioled simple leaves from the rootstock. While recent manuals state that this is occasionally true for the genus, the speaker had failed to find specimens in any herbaria examined which exhibited this character.

Mr. M. B. Waite stated that the ordinary two weeks' interval had proved too long in spraying apple trees for bitter rot. In experiments the present season in Virginia, the third treatment was made just after the petals had fallen and while the trees were moderately covered with foliage. Two weeks from this time the trees were found to have made a very rapid growth of six to ten inches, and three or four new full-grown leaves had developed on each twig, which were, of course, unprotected by the spray. In a few cases these leaves had become infected with fungi, probably the bitter rot fungus. At the time of the fourth treatment, these leaves were, of course, thoroughly covered with the mixture and protected from further infection, but it is interesting to know that the two weeks' interval at this period of rapid leaf formation was long enough for leaves to form and become infected with the fungus before they could be protected by the spray. The inference is that the interval between the third and the fourth spraying should in this case be shortened.

Mr. Wm. A. Taylor called attention to some field experiments recently made, to ascertain in a practical way to what extent bees are responsible for the spread of pear blight. In these experiments, which were conducted by Mr. Charles Downing in Kings County, Cal., where blossom blight was very destructive last year, the members of the association of bee keepers agreed to remove their bees to a minimum distance of two miles from the pear orchards for the blooming season. It was found during the blooming season that a considerable number of swarms were left in the area in question, including one lot of thirty or forty swarms that had been overlooked. Certain trees of P. Barry, Clairgeau, and Bartlett pears were covered with mosquito netting before the blossoms opened, to exclude all the larger insects, including bees. When the trees blossomed it was found that the trees of P. Barry and Clairgeau, which blossomed early, when nearby orchards of apricots and peaches were in bloom, were little visited by bees. Both covered and uncovered trees of these varieties, to the number of 3,000, set a full crop of fruit, with no blight infection except on a few late blossoms. The uncovered Bartletts, which blossomed later, beginning just before the peaches and apricots were through blooming, were well covered with bees almost from the start. The blossoms on the uncovered Bartlett trees were badly blighted, and very little fruit set on them except from the first blossoms, which opened before the bees began their visits. On the covered Bartlett trees more fruit set than on any other Barlett trees in the orchard. Some blossom blight appeared on the covered trees, but upon examination some dead bees were found inside the netting, which had been slightly torn by storms.

Mr. Downing estimates the financial loss on his Bartlett pears last season due to blossom blight at $10,000, and his loss on the same variety this year from the same cause at 1,000 tons of fruit on 9,000 trees. He concludes that so long as there are blight-infected pear trees in his locality the crop of Bartletts will be destroyed if the bees have access to them. The fact that the covered trees set fair crops of fruit appears to indicate that cross-pollination of Bartletts was not necessary in that locality this season.

In the discussion of pear blight in California, Mr. Waite stated that the blight bacteria were usually carried from the gummy exudation of hold-over cases by flies and wasps, flies being the principal agents in the transportation of the virus. After the first blossoms have been infected in this manner, the regular flower-visiting insects, of which the common honey bee and the sweat bees, belonging to the genera *Halictus* and *Andrena* are examples, carry the disease from one blossom to another. These flower-visiting insects are very efficient in transporting the disease, and other things being equal, the later a pear blooms the more complete its infection. If our pomaceous fruit blossoms continued to open during the summer, the destruction by pear blight would doubtless be almost complete. Ordinarily the closing of the blooming period terminates the multiplication and distribution of the disease.

Mr. M. A. Carleton discussed 'The Spread of Smut and Bunt in Wheat as affected by Dry Seasons and the Earliness of Varieties.' It has been pretty well known for some time that smut and bunt in cereals are much more prevalent in dry seasons and in dry regions. Experiments and observations made by the U. S. Department of Agriculture have also shown that these fungi, when attacking wheat particularly, are more likely to appear in early varieties than in those that mature later. Thus it is very common for Japanese wheats to be infested with smut when introduced into this country, and Japanese varieties are always quite early in ripening. Now, as the tendency of dryness and heat is to produce early ripening of plants, it appears that there may be some relation between these parallel facts, and the question is a very interesting one as to why these conditions exist. As a rule the smut is propagated by germinating in the ground with the grain itself, infecting the young plant at that time and growing up through the plant as the plant grows, finally breaking out at the surface in the wheat head. One of two things therefore it seems may be true, either that the abnormal condition of the plant produced by its infection with the smut causes the plant to ripen earlier, or, on the other hand, that the early maturity of the plant allows the smut to work its way to the surface before the plant has grown entirely beyond it. Many observations seem to show that the latter is true, although it is by no means established. The tendency in dry seasons and in early ripening is always to produce more fruit or grain and less of the vegetative portion of the plant. As the smut finally produces its spores at the surface in the head, this condition would naturally favor the maturity of the smut. On the other hand, in later ripening sorts and in moister regions or seasons of greater moisture, the growth of the plant being more rapid and the maturity of the fruit occurring later, the plant is enabled in a sense to outgrow the development of the smut.

A portion of the evening was devoted to a symposium on 'Environment as a Factor in Natural Selection,' the discussion being led by Messrs. W. J. Spillman and H. J. Webber. In the discussion Professor Spillman stated that environment is not only a factor in natural selection; it is the whole of it. It is more than this, for it is a factor in variation. As stated, therefore, the subject covers the whole field of natural selection. It is probable that natural selection has been overworked, and particular attention is called to the fact that much, perhaps most, variation is neither useful nor harmful, and therefore not amenable to the influence of natural selection. If this is true a great deal of what we see in living organisms is not due to natural selection, but merely to fortuitous variation, perhaps to mutations, as De Vries would have us believe.

It is really change of environment that is important in natural selection. These changes are frequently favorable in that they remove a condition which made selection more strict. Examples of these are common in the case of organisms transplanted to a new habitat, where their natural enemies are absent. Under such conditions variations become permissible that were not possible under the old conditions, and what was before an unimportant species may assume a very important place in the economy of nature.

Mr. Webber stated that while the majority of variations induced directly by the influence of environment are not inherited; nevertheless, the influence of environment serves to destroy those individuals which do not vary in the direction of adapting themselves to the environment. It is only those individuals, therefore, which possess desirable variations that are able to produce seed for the next generation. The action of the environment in the next generation would be exactly the same, those plants only which vary in the direction of fitting themselves to the environment being able to survive and produce seed. In this way natural selection would eliminate such variations as were unfitted to the environment, so that only those plants best fitted would propagate. This action continued through several years would eventually result in rendering hereditary the characters fitted to the environment.

HERBERT J. WEBBER,
Corresponding Secretary.

DISCUSSION AND CORRESPONDENCE.

WHAT IS NATURE STUDY?

THERE seem to be many conflicting definitions in attempts to answer the above question. Here are two examples: "Nature study, as used in this paper, is understood to be the work in elementary science taught below the high school—in botany, zoology, physics, chemistry and geology. We should aim to define results. Gushing sentimentalism or mere rambling talks will be as barren in results as undigested statistics. To avoid this, the teacher should always have a definite plan before her when the lesson begins."—D. Lange, Supervisor of Nature Study, St. Paul, Minn.

"Nature Study is seeing the things which one looks at, and the drawing of proper conclusions from what one sees. Nature study is not the study of a science, as of botany, entomology, geology and the like. It is wholly informal and unsystematic, the same as the objects are which one sees. It is entirely divorced from definitions, or from explanations in books. * * * To-day it is a stone; to-morrow it is a twig, a bird, an insect, a leaf, a flower. * * * The problems of chemistry and of physics are for the most part unsuited to early lessons in nature study.

"If nature study were made a stated part of a curriculum, its purpose would be defeated."—L. H. Bailey, Cornell University, N. Y.

I have observed the different methods of teaching botany and zoology for many years past. So far as this country is concerned, I think what is now correctly termed nature study started with Louis Agassiz at Harvard, where he invariably set his special students in zoology to work on a starfish, a lobster, a clam or some other animal; not one specimen of one of these, but many of them, not alone those that were full grown, but those of all ages; not only dead specimens, but those that were alive, always with numerous comparisons. For months, the use of books was positively forbidden; and all that was told the student, excepting a few names of parts, was, 'You are right,' or 'You are wrong,' and if wrong, the student was kept at the work until he saw the thing right.

Agassiz was overflowing with enthusiasm. He would throw up both arms with exclamations of delight on seeing a specimen of a common shell-fish that was overgrown. This earnestness and enthusiasm helped secure faithful work from his students. Since working under Agassiz I have not had the slightest doubt that his method of studying nature or nature study was unsurpassed for advanced students. This method made a lasting impression on Harvard, on her presidents, her professors, and all the students who took his kind of work. Through these students of Agassiz and their students down to the third generation, this spirit of independent work has come filtering along for fifty years or more, till it has finally become widespread and deeply seated, and has recently burst forth into a great flame.

After the manner of Agassiz with his post-graduates, so the teacher of the grades below the high school will treat her young students, of course giving easier problems requiring but a little time each day. The teacher will show her interest, tact and enthusiasm to draw out the best work from her pupils. By all devices, she will seek to get the results of the combined observations of all members of the class before she lets them know her own views on the subject, and even then parts of the work may be left with pupils for further investigation.

With much that is good in nature study comes much that is positively injurious, and unfortunately large numbers are unable to distinguish between the true and the false. One writes a little book giving it some fancy title, distorts the drawings of some seeds and seedlings, inserting outlines of children's faces thereon; she writes some marvelous stories, and all these to help arouse and retain the interest of the child.

I have in my possession a neat drawing made by a student. He made two drawings to represent two honey bees just about to visit apple blossoms. The bees are not alike; each has two wings only; the heads and legs are unlike anything ever attached to bees. The apple blossoms are five-lobed (gamopetalous), with three stamens growing from the base of each lobe of the corolla. He has made drawings of imaginary insects seeking imaginary nectar from imaginary flowers. This student was trained in a state normal school. Such caricatures are absolutely worthless, in fact injurious, to any young person who makes them or even looks at them.

W. J. Beal.

Agricultural College, Mich.

ŒCOLOGY.

TO THE EDITOR OF SCIENCE: I share Professor Ganong's surprise that, after the word 'ecology' had been fully discussed in your columns by many leading naturalists (of whom Mr. Ganong was one), you should have admitted my belated remarks. I can only suppose that you recognized, what Mr. Ganong seems to have forgotten, that I am not responsible for the intervention of the Atlantic Ocean. Still I confess that I should not for the moment have forgotten the difference between the American and English languages. I can only say that if the spelling 'ecology' be not a vagary, the fact is to be regretted, since such contractions undoubtedly mislead those who wish to follow the excellent example of one of your correspondents and to use the Greek lexicon. I do not recognize the parallel with 'economy,' a word which came to us through the French, and which is a familiar everyday word, whereas 'œcology' is, and no doubt will long remain a purely technical term. I infer that here I have the support of Mr. Lester F. Ward.

As to the meaning of 'œcology,' I am glad to find myself in entire agreement with Mr. Ganong and Dr. Theodore Gill. But when the former belabors me for bringing a false accusation against botanists, in saying that they have restricted the meaning of the term, I must defend myself. I do not profess to speak with the authority of Mr. Ganong, whose studies in this branch of natural history we all admire; I speak merely as a casual skimmer of such publications as SCIENCE. It certainly appeared to me that the two authors whose papers suggested the recent discussion, namely Mr. H. S. Reed and Mr. H. C. Cowles, used the term as meaning 'œcological plant-geography.' The former entitles his paper 'The Ecology of a Glacial Lake'; does Mr. Ganong seriously maintain that this means 'The science of the adaptation of a glacial lake to its surroundings?' The latter (whatever he may have said 'in his elaborate paper' here distinctly asserted that the 'phytogeographic' was one of the two aspects presented by 'all ecological problems,' and his paper dealt solely with this aspect. Your own editorial explanation of the term laid even more stress on geographic distribution. Surprised at this, I consulted one or two botanical friends, who assured me that by 'œcology' they really did understand the study of plant-associations. I therefore turned to Mr. Robert Smith's paper in *Natural Science* and found that he did not use the term 'œcology' in the same sense as the botanists just alluded to, but used instead the phrase 'œcological plant geography,' which I quoted in my previous letter. Mr. Ganong need not have hunted up all the instances of the words 'œcological' and 'œcology' in Mr. Smith's paper. I admit that the latter does occur once (Mr. Ganong says 'four times'). But my whole point was that Mr. Smith used it with its full and correct meaning, and that he did not mention it as an equivalent for the subject of his paper.

I trust Mr. Ganong will now see that, though my ignorance of botanical literature may have led me to give too extended a form to my statement, still the use of the term in a restricted sense does actually obtain among botanists. Indeed I am assured by a botanical colleague that such use is increasing. I hope therefore that some of Mr. Ganong's hearty blows will have glanced off me on to the shoulders of the real offenders.

The whole object of a technical terminology is precision and unambiguity of language. The moment a term ceases to be used in the strict sense of its original proposer, this object is defeated.* The fact that there are signs of such a change in the case of the word 'œcology' justifies a protest before it is too late.

F. A. BATHER.

MASS AND WEIGHT.

TO THE EDITOR OF SCIENCE: I notice in your issue of June 13, a communication from Dr. Goodspeed, on the subject of 'Mass and Weight.' I am glad that attention is called

* Professor W. M. Wheeler uses 'Ethology' "in the place of the less satisfactory 'ecology'" (SCIENCE XV., p. 774, May 16, 1902). Why is 'ecology' less satisfactory, if not for this very reason?

to this subject, as I think that some reform is greatly needed. I agree with him in all that he says except that I do not think the term 'measurement' is the proper one to take the place of the common title 'weights and measures.' Under the latter title is always understood a list of the *units* and their equivalents, and therefore the term 'measurement' does not apply. In view of the fact that the units of weight are *measures* quite as well as the units of length are, it seems to me a much better title would be simply 'measures,' and I would urge the adoption of that title in place of the word 'measurement,' suggested by Dr. Goodspeed.

Carl Hering.

Philadelphia.

SHORTER ARTICLES.

DIVERGENCE OF LONG PLUMB-LINES AT THE TAMARACK MINE.

In September last two very long plumb-lines were hung in No. 5 shaft of the Tamarack Mine at Calumet, Michigan. They were 4,250 ft. in length, being longer than in any previously recorded instance. They were of No. 24 piano wire and the bobs were of cast iron, weighing fifty pounds each. Great care was taken that there should be no interference from projecting objects nor from dropping water, of which indeed there is not a great deal in the shaft. Measurements between the lines taken at surface and at their lower extremities showed a divergence to the amount of 0.11 ft. A divergence of 0.07 ft. remained after the western wire had been moved about 1.25 ft. further west to ensure its freedom from obstacles. Thinking that the air pipes which run down the western end of the shaft might, through magnetic action on the bob nearest them, be causing this divergence, I advised the use of lead bobs in a plumbing of No. 2 shaft, which took place a little later. Although the length of the lines in No. 2 was about 120 ft. less than when they hung in No. 5, and although the lead bobs were used, there was yet a divergence of 0.10 ft.

The publication about this time in the Houghton *Daily Mining Gazette* of the fact that a divergence had been observed attracted wide attention, and brought forth many attempts to explain its existence. Those immediately cognizant of the conditions had no satisfactory theory to offer. One of the explanations was that the divergence was due to the greater attraction of the material at the end of the shaft for the bob hanging nearest it. It is remarkable how many engineers and other trained persons held to this theory. There seems to exist a general lack of appreciation of the forces of gravitation, except in the single instance of the force between the earth and objects upon it. It is of course true that the attractions on either bob toward the ends of the shaft are different, the stronger being toward the end nearest to which it hangs. Furthermore, these differences of attraction tend to diverge the lines. Their amounts, however, are in this case so insignificant as to put them quite out of consideration in attempting to explain the divergence. Their sum is only a few hundredths of a grain, and the consequent divergence only about 0.001 ft.

Professor Hallock, of Columbia University, suggested the theory of repulsion between like poles at the lower extremities of the wire, but afterwards modified this to include repulsion between like consequent poles distributed along the wires.

Permission having been granted me to carry on further experiments in No. 4 shaft of the Tamarack Mine, there were hung in this shaft bronze wires No. 20 B. & S. gauge, carrying 60-pound lead bobs. These lines were approximately 15 ft. apart and 4,440 ft. in length. By a simple system of triangulation the distance between the mean positions of their lower extremities was determined, while the distance between them at surface was directly measured. It is thought that these distances were compared with an error not greater than 0.003 ft. A small convergence of 0.028 ft. was observed. The steel wires were then hung in the same position at the top, and the positions at the bottom observed, both with lead and with iron bobs. The bronze wires were hung a second time, but somewhat nearer together, and were found practically parallel. The steel lines showed a slight convergence. Subsequently the bronze wires with lead bobs were hung in No. 5 shaft in the same position, as nearly as might be, as was occupied by the steel wires in September. The divergence was greater, amounting this time to 0.141 ft. The results are exhibited in the following table:

Date, 1902.	Shaft.	Wires.	Bobs.	Distances in feet.		Con-vergence—. Divergence+.
				Sur-face.	Lower Ex-trem-ities.	
Jan. 3	No. 4	Bronze.	Lead.	15.089	15.061	−0.028
" 6	" 4	Steel.	Lead.	15.089	15.074	−0.015
" 6	" 4	Steel.	Iron.	15.089	15.062	−0.027
" 9	" 4	Bronze.	Lead.	14.607	14.611	+0.004
" 16	" 5	Bronze.	Lead.	16.709	16.850	+0.141

The data shown in the table seemed to afford ample experimental proof that neither gravitation nor magnetism could account for the divergence originally observed. Further, it seemed that the results pointed clearly to the currents of air in the shafts as the disturbing cause.

Until No. 5 shaft is connected with other portions of the mine its ventilation is accomplished by dividing it into two parts by means of a tight casing which sets off one compartment and the ladder-way, at the western end of the shaft, to serve as an air chimney for the up-cast draft. At the time of the September and January plumbings there existed at different levels a number of openings in this casing. The west wire hung in the air chimney, and these openings permitted a rush of air from the down-cast side into the up-cast portion, the effect of which would be to move the west wire toward the west and thus produce a divergence. To make the proof as complete as possible it was decided to hang the bronze wires once more in this shaft, but to hang the west one in the compartment next the air chimney, rather than in it. It seemed that if both wires were hung in the down-cast portion the divergence ought to disappear. Moreover, communication between the air chimney and the down-cast portion was carefully stopped off as far down as the extent of the wires, and, to further prevent circulation, the shaft was covered at the top as soon as the wires were in position. Since a considerable difference in temperature exists between the bottom of the shaft and the surface, it was not possible to stop all circulation. There remained a considerable convection circulation whose down-cast portion was concentrated along the casing above referred to. The measurements between the wires were, at surface 11.944 ft., at bottom 11.962 ft., showing a divergence of 0.018 ft. This divergence was easily accounted for by the convection current just described.

The difference between the divergence of the steel wires hung in this shaft in September, and of the bronze ones in January is explained by the fact that the circulation in the warmer weather of September was much less vigorous than in January and, further, that the steel wires afforded the smaller surface to be acted upon.

The question of air currents had been considered early in the experiments. That they could account for the divergence was very slowly admitted by the observers, inasmuch as it was difficult to believe that currents of air could be of the steadiness, in both volume and direction, which would be necessary to permit the constancy which was observed in the mean positions of the lines. The mean positions were observed on scales, placed close to the wire. Most of the time scales divided into sixteenth inches were used. For hours at a time the variations of the mean position of a wire would not exceed three or four tenths of a scale division. The mean position was determined by drawing the wire aside and allowing it to vibrate, as in determining the resting point of a balance by the method of vibrations.

The responsibility of the air currents once admitted, it was found by studying the conditions in No. 2 shaft that the divergence there observed could be satisfactorily explained. The shaft is down-cast and the air leaves it at the west end to reach the mine. The small convergence observed in No. 4 shaft can likewise be accounted for by the swirl of the currents as they enter this shaft, which is up-cast. The contour of the walls of the plats is such that the currents of air hugging the outside of the curve as they enter the shaft will have a tendency from the west wall toward the center. Moreover, it appears that this tendency will be stronger close to the wall than a little distance away. When therefore on the 9th of January, the west wire was moved eastward, lessening the distance between the lines, the wires hung more nearly parallel than when this wire was close to the wall of the shaft.

It seems therefore that a very simple cause was at the bottom of the divergence. The remarkable fact is that the currents of air should be so constant in their action. When, however, the great depth of the shafts is considered, also the constancy for considerable periods of time of the temperatures which may influence these currents, it seems reasonable that this steadiness should exist.

F. W. McNair.
Michigan College of Mines,
Houghton, Mich.

SEX IN SEED PLANTS.

Probably everyone who has tried it will say that it is not easy to teach students the relation between pteridophytes and seed plants. Yet by following closely the origin of the sporophyte and its gradual evolution the subject can be made clear if all conditions are favorable. One important condition is that the text-books consulted by the student shall be perfectly clear, that there shall be no confusion of terms.

In popular accounts of plants, as in popular works on science generally, one must expect to find technical subjects treated in rather offhand fashion. But in works planned for college students it does not seem unreasonable to ask for simple accuracy. Now it has long been known that, among the seed plants, 'the plant' is the sporophyte, a non-sexual organism. The stamens therefore cannot be male organs nor the carpels female organs. Placing the pollen upon the stigma is not fertilization and every botanist knows it. There are no such things as male and female flowers, nor flowers which are unisexual or hermaphrodite.

Notwithstanding these well known facts, many botanists continue to use these inaccurate expressions. Practically all of the European botanical journals are serious offenders. In our own country the first class journals use the modern terminology but many of the most widely used text-books do not. The most recently issued American text-book, a work intended for university students, contains the misleading and irrational terms mentioned above.

Methods of teaching botany are frequently discussed at educational conventions. To the writer it seems that what we need is not some new and fancy method of teaching but a knowledge of facts by the teacher and an ability to select a text-book which is clear and accurate in its terminology—not muddled and confused.

Francis Ramaley.
University of Colorado.

HARVARD COLLEGE OBSERVATORY ASTRONOMICAL BULLETIN.

The determination of the law governing the variation in light of the planet Eros (433) is one of the most interesting problems in Astronomical Photometry. A similar variation in light of the planets Sirona (116) and Tercidina (345) has been announced by Dr. M. Wolf, of Heidelberg. Both objects are favorably situated for observation this summer. The opposition of Sirona occurs on June 15, 1902, Magn. 10.9. Accordingly the following ephemeris for Greenwich Midnight has been computed by Mr. F. E. Seagrave, of Providence, R. I., from the elements given in the Berlin Jahrbuch for 1904.

EPHEMERIS.

1902.	J. D.	R. A. h. m. s.	Dec. ° ′ ″	Log r	Log Δ
May 26.5	241 5896	17 53 45.8	—24 54 30	0.45135	0.27197
June 5.5	5906	17 45 10.2	—25 5 25	0.45349	0.26518
June 15.5	5916	17 35 36.5	—25 12 39	0.45560	0.26468
June 25.5	5926	17 26 7.8	—25 15 52	0.45767	0.27063
July 5.5	5936	17 17 43.2	—25 15 49	0.45969	0.28260

Photographs taken at Cambridge on June 5 and June 8, 1902, with the 8″ Draper Telescope, indicate a correction to this ephemeris in R. A. of +0.1m, and in Dec. of —1′. Photographic enlargements of this region will be furnished to observers who will undertake the required observations.

The opposition of Tercidina occurs on August 3, 1902, magn. 11.5, in R. A. 20h 50.4m, Dec. —0° 40′. Daily motion in R. A. —0.9m, in Dec. —4′.

Edward C. Pickering.

A GRADUATE SCHOOL OF AGRICULTURE.

The first session of a graduate school of agriculture held under the auspices of the Ohio State University, and with the cooperation of the United States Department of Agriculture and the Association of American Agricultural Colleges and Experiment Stations, will open at Columbus on July 7 and will continue for four weeks. The purpose of the school is to give advanced instruction in the science of agriculture, and particularly in the methods of investigating agricultural problems and teaching agricultural subjects. Only persons who have completed a college course and taken a bachelor's degree, or who are recommended by the faculties of the colleges with which they are associated, will be admitted to the privileges of the school. Instruction will be given in four courses—agronomy, zootechny, dairying, and animal and plant breeding. The courses in these subjects will run parallel; except that the course in breeding will be so arranged that it can be taken by students in any of the other courses. The Saturday morning periods will be devoted to lectures and conferences on agricultural pedagogy and special topics of general interest. The equipment of modern dairy apparatus and machinery and apparatus for instruction in soil physics is especially complete. Some of the apparatus used in the investigations of the Bureau of Soils of the U. S. Department of Agriculture will be transferred to Columbus for the use of the school. This bureau is now conducting a soil survey of the region in the immediate vicinity of Columbus, and the students of the school will have an opportunity to observe the field methods of this survey.

The breeders of Ohio will contribute live stock for judging and demonstration purposes in connection with the courses in zootechny and animal breeding. An especially selected library of works on agriculture and agricultural science will be provided.

Dr. A. C. True, chief of the Division of Agricultural Colleges and Experiment Stations of the Department of Agriculture, is dean of the school. The faculty will consist of about thirty instructors, including the heads of the agricultural departments of state universities and agricultural colleges and the directors and other officers of experiment stations in different parts of the country, as well as chiefs of bureaus and other officers of the U. S. Department of Agriculture.

SCIENTIFIC APPOINTMENTS UNDER THE GOVERNMENT.

Several positions in the scientific departments of the government will be filled as the result of civil service examinations in July.

On July 10 an examination will be held to fill three vacancies in the position of laboratory assistant in the National Bureau of Standards, at a salary of $900, $1,000 and $1,400 per annum, and to other similar vacancies as they may occur.

The examination will consist of the subjects mentioned below, which will be weighted as follows:

Education and training, including training in mathematics and mathematical physics. (State all courses in these subjects taken in college or later.)	20
Experience, including (*a*) laboratory work in electricity and general physics done in college or later; (*b*) any other experimental work or original research; (*c*) other experience likely to be helpful in the position of laboratory assistant	30
One or more of the following optional subjects: (*a*) Theoretical and applied electricity and electrical testing; (*b*) Theoretical and experimental optics; (*c*) Mechanics of solids and fluids with applications to the testing of weights and measures	50

Competitors will be assembled only for the tests under the third subject. Three hours will be allowed for subject *a*, and two hours each for subjects *b* and *c*. Applicants must show that they have been graduated from colleges or technical schools, or show that they have obtained an equivalent scientific training. The Department desires that the appointee be not less than 20 nor more than 40 years of age and be in good physical condition. A preliminary rating will be made on the first two subjects as shown by the application and accompanying vouchers, and those applicants who fail to attain at least 70 per cent. on this portion of the examination will not be given the tests under the third subject.

On July 8 and 9 examinations will be held to fill at least four vacancies as computers in the Coast and Geodetic Survey at a salary of $1,000 a year. The subjects and weights are:

Algebra	10
Plane and solid geometry	10
Trigonometry	15
Elements of calculus	15
Practical computations	50

On July 11 and 12 an examination will be held to fill twelve vacancies in the position of aid in the Coast and Geodetic Survey, at a salary of $720. The age limit is eighteen to twenty-five years and the subjects and weights are:

Mathematics, including the elements of calculus	10
Practical computations	10
Astronomy	10
Physics	10
Surveying	10
Modern languages, translation from one European language	10
Drawing and descriptive geometry	10
Training and experience	10
Physical examination	20

On July 15 there will be an examination to fill the position of assistant in the Road-material Laboratory, Division of Chemistry, Department of Agriculture, with a salary of $600 with prospects of promotion; and on July 15 and 16 there will be an examination for assistant (piece-work computer) in the Naval Observatory and the Nautical Almanac Office.

THE PITTSBURGH MEETING OF THE AMERICAN ASSOCIATION.

Arrangements have now been made so that certificates will be honored from points in the territory of the Western Passenger Association which show the purchase of tickets for the Pittsburgh meeting of the American Association on June 26–30 inclusive in addition to June 19–25 inclusive.

George A. Wardlaw.

SCIENTIFIC NOTES AND NEWS.

Sir Joseph Dalton Hooker has been appointed a foreign knight of the Prussian Ordre Pour le Merite for Science and Arts. Sir Joseph Hooker, who was director of the Kew Botanical Gardens from 1865–1885 and president of the Royal Society from 1872–1877, will celebrate his eighty-fifth birthday on June 30.

The Huxley Lecture at Charing Cross Hospital will be delivered this year by Dr. William H. Welch, of the Johns Hopkins University.

Lord Rayleigh has been elected a corresponding member of the Vienna Academy of Sciences.

Dr. S. Alfred Mitchell, tutor in astronomy at Columbia University, has been elected a fellow of the Royal Astronomical Society of England.

The officers of the American Medical Association elected at the Saratoga meeting are: *President,* Frank Billings, of Chicago; *Vice-Presidents,* W. A. Witherspoon, of Tennessee, G. F. Comstock, of New York, C. R. Holmes, of Ohio, James H. Dunn, of Minnesota; *Secretary,* G. H. Simmons, of Illinois; *Treasurer,* H. P. Newman, of Illinois; *Orators:* Medicine, J. M. Anders, of Philadelphia; Surgery, A. F. Jones, of Omaha; State Medicine, W. H. Welch, of Baltimore. Little Rock, Arkansas, was recommended for the next place of meeting.

The North Carolina Academy of Science was founded at Raleigh, on March 21, 1902. The following officers were elected for the current year: *President,* W. L. Poteat, Wake Forest College; *Vice-President,* T. Gilbert Pearson, State Normal College; *Secretary and Treas-*

urer, Franklin Sherman, Jr., State Entomologist; *Executive Committee,* W. L. Poteat, Franklin Sherman, W. W. Ashe, H. H. Brimley, Tait Butler, J. L. Kesler, B. W. Kilgore, F. L. Stevens and H. V. Wilson. The first meeting for the presentation of papers will be held during the first week in October.

OXFORD UNIVERSITY will on June 24 confer its honorary degree of D.C.L. on William H. M. Christie, C.B., F.R.S., Astronomer Royal, and on Arthur W. Rücker, F.R.S., principal of the University of London. The degree will also be conferred on Mr. Choate, Ambassador of the United States.

PRINCETON UNIVERSITY has conferred the degree of LL.D. on Mr. Morris K. Jesup, president of the American Museum of Natural History.

PRESIDENT NICHOLAS MURRAY BUTLER, of Columbia University, has received the degree of doctor of laws from Princeton University. It is understood that he will receive the same degree from Yale University and from the University of Pennsylvania. He will make the commencement address at the latter university.

COLUMBIA UNIVERSITY has conferred the degree of D.Sc. on Professor S. B. Christie, who has held the chair of mining and metallurgy in the University of California since 1885.

M. ÉMIL LAURENT, professor of agriculture in the Belgian national school at Gembloux, has been elected a correspondent of the Paris Academy of Sciences.

DURHAM UNIVERSITY has conferred the degree of D.C.L. on Sir W. S. Church, president of the Royal College of Physicians, London, and on Dr. Thomas Annandale, professor of clinical surgery at Edinburgh.

PROFESSOR CH. RICHET, the eminent French physiologist, has resigned the editorship of the *Revue Scientifique,* which he has held for twenty-five years. He is succeeded by M. Héricourt.

UNIVERSITY AND EDUCATIONAL NEWS.

DR. FRANCIS L. PATTON resigned the presidency of Princeton University on June 9, but retains the Stuart professorship of ethics and the philosophy of religion. Dr. Woodrow Wilson, McCormick professor of jurisprudence and politics, was elected as his successor.

AT the commencement exercises at the Johns Hopkins University last week, President Remsen announced that over $900,000 had been subscribed toward the million dollar endowment fund.

THE University of Pensylvania has received a gift of $100,000 for the construction of the new medical buildings, the name of the donor being withheld for the present.

MR. A. A. POPE, of Cleveland, has given the Western Reserve University $100,000 for buildings.

PRESIDENT JOSEPH SWAIN, of Indiana University, accepted the presidency of Swarthmore College, on condition that the endowment be increased by $400,000. This sum has now been subscribed.

WELLS COLLEGE has received $50,000 from Mr. Henry A. Morgan and $25,000 from Mr. N. L. Zabriskie for buildings and equipment.

IT is announced that the donors of the new physical laboratory for Wesleyan University, which is to cost $75,000, are Mr. Charles Scott, Sr., Philadelphia, a trustee of the university, and Mr. Charles Scott, Jr., New York, a graduate of the class of '86. The building is to be a memorial of John Bell Scott of the class of '81.

THE appeal by the governors of University College, Dundee, has brought in over £24,000.

DR. E. H. GRIFFITHS, principal of University College, Cardiff, and formerly lecturer on physics at Cambridge, has offered to give his collection of apparatus to the college, if a building for a laboratory is provided at a cost of £2,000. He suggests that the laboratory be named in honor of the late Viriamu Jones. If Cardiff does not accept the offer, the collection will be presented to the National Physical Laboratory at Teddington.

THE Sir John Cass Technical Institute, London, erected at a cost of over $150,000, was formally opened on May 5 by Lord Avebury.

The draft charter of the proposed University for Liverpool, settled by the council of University College, gives powers as to the conferment of degrees in all the recognized faculties, as well as in the faculty of commerce, which embraces the sciences of economics, geography, banking and commercial law. It also gives powers to admit new constituent colleges; to recognize halls of residence for students; to establish new professorships and lectureships; and provides for the establishment of external examiners.

The following promotions have been made at the Johns Hopkins University:—George B. Shattuck, Ph.D., now associate, to be associate professor of physiographic geology; Caswell Grave, Ph.D., now assistant, to be associate in zoology; Louis A. Parsons, Ph.D., to be assistant in physics; William G. MacCallum, M.D., now associate, to be associate professor of pathology; Guy L. Hunner, M.D., now instructor, to be associate in gynæcology; Walter Baumgarten, M.D., to be assistant in medicine; Florence R. Sabin, M.D., to be assistant in anatomy; Benjamin R. Schenck, M.D., to be instructor in gynæcology.

Dr. H. C. Warren has been promoted to a full professorship of experimental psychology at Princeton University.

Mr. George F. Gebhardt, instructor in the Armour Institute of Technology, at Chicago, has been elected to the chair of mechanical engineering.

The following appointments and changes in the scientific faculty of the University of North Carolina were announced at the recent commencement of that institution: W. C. Coker, Ph.D. (Johns Hopkins), now at Bonn, associate professor of botany; J. E. Duerden, Ph.D. (Johns Hopkins), acting-professor of biology during the leave of Dr. H. V. Wilson, head of the department; Ivey F. Lewis, A.B. (U.N.C., 1902), assistant in biology; M. H. Stacy, Ph.B. (U.N.C., 1902), instructor in mathematics; Archibald Henderson, Ph.D. (U.N.C.), associate professor of mathematics, was given a year's leave of absence, during which period he will fill an instructorship at the University of Chicago; George P. Stevens, A.B. (U.N.C., 1902), assistant in mathematics; J. E. Latta, A.M. (U.N.C.), instructor in physics, was given a year's leave of absence. He has accepted a scholarship at Harvard; H. R. McFadyen was appointed assistant in physics; Hazel Holland, assistant in chemistry, and W. M. Perry, assistant in pharmacy.

Dr. Cady Staley, since 1886 president of the Case School of Applied Science, has resigned.

Mr. John W. Abercrombie has been elected president of the University of Alabama. The Rev. Dr. Guy P. Benton, president of the Upper University of Iowa, has been elected president of Miami University.

Dr. James H. Carlisle has resigned the presidency of Wofford College, at Spartanburg, S. C., and Professor Henry Nelson Snyder, professor of English, succeeds him. Dr. Carlisle, who is seventy-seven years old, has been elected president emeritus and professor of astronomy and ethics.

Dr. Thomas Ruggles Pynchon, since 1877 professor of moral philosophy at Trinity College, has resigned and has been made professor emeritus. Dr. Pynchon was president of Trinity College from 1874 to 1877 and was from 1854 to 1877 professor of chemistry and natural sciences.

Mr. Graham Balfour, M.A., assistant secretary of the Oxford Examinations Delegacy, has been appointed director of technical instruction under the Staffordshire County Council, in succession to Professor Thomas Turner, recently elected to the chair of metallurgy at Birmingham.

Mr. Douglas A. Gilchrist, B.Sc., professor of agriculture and director of the agricultural department at the college, Reading, has been appointed professor of agriculture at the Durham College of Science, Newcastle, in succession to Professor T. H. Middleton, M.Sc., who was recently elected to the chair of agriculture in the University of Cambridge.

Mr. Herbert Stanley Jevons, son of the late Professor Stanley Jevons, has been appointed to a lectureship in mineralogy at the University of Sydney, New South Wales.

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, JUNE 27, 1902.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*THE UNIVERSITIES IN RELATION TO RESEARCH.**

IT is now many years since I came to the conclusion that the provision of adequate facilities for research is one of the prime necessities of university education in Canada; and it is with the object of accelerating the movement which has already begun in this direction that I have selected the relation of the universities to research as the topic of my remarks on this occasion.

It will perhaps be expedient for me at the outset to say that I propose to use the word research in its widest meaning, *i. e.*, as indicating those efforts of the human mind which result in the extension of knowledge, whether such efforts are exerted in the field of literature, of science or of art. It is a common mistake to apply the term research to what we somewhat erroneously denominate as 'science,' meaning thereby the physical and natural sciences. This limitation is comparatively modern, and science so defined is after all only a part of human knowledge.

The limits of research in its wider sense are coterminous with the knowable, and research itself is of very ancient date. The fund of knowledge accumulated even before the Christian era was enormous. This great fund, however, remained stationary,

* Address of the President of the Royal Society of Canada at the Toronto Meeting, May 27, 1902.

or nearly so, throughout the Dark and and Middle Ages. During this period of mental stagnation, authority was the watchword of the learned. All knowledge was supposed to have been already discovered, and the efforts of the schoolmen were devoted to the application of this body of truth to life and conduct. This mediæval point of view has been quaintly and aptly put by Chaucer:

Out of olde feldies, as man saieth,
Comith all this newe corne from yere to yearn;
And out of olde bokis, in good faithe,
Comith all this newe science that menne learn.

With the Renaissance began a new epoch, an epoch in the midst of which we are still living. It marked, as has been well said, 'the liberation of the reason from a dungeon, the double discovery of the outer and inner world.' The study of the humanities, which was an incident of the Renaissance, rendered available to modern men the wisdom of the ancients. But much of the old knowledge was found to be spurious when examined with the new light, and even the authority of Aristotle, the demigod of the scholastics, was discredited. Nothing henceforth was to be accepted on trust, and the injunction to 'prove all things' became the watchword of the learned.

Although the Renaissance marked the regeneration of philosophy, of criticism, and in general of the whole process of thought, it especially denoted the birth of the physical and natural sciences, and hence their rise and progress may be taken as best illustrating the working of the new spirit of research. Roger Bacon in the thirteenth century protested vainly against the despotism of Aristotle, and advocated a new and fruitful learning which should be based upon experience. In the two centuries which followed, those scholars described by Whewell as the 'Practical Reformers,' working in their primitive laboratories, established a sound basis for a future natural philosophy. One of these, Leonardo da Vinci (1452–1519), both a practical and a theoretical philosopher, anticipated modern science in his remark: "The interpreter of the artifices of nature is experience, who is never deceived. We must begin from experiment and try to discover the reason." Telesio (1508–1588), called by Francis Bacon 'primus hominum novorum,' said: "The construction of the world and the magnitude and nature of the bodies in it are not to be investigated by reasoning, as was done by the ancients; but they are to be apprehended by the sense and collected from the things themselves." These were some, but not nearly all, of the forerunners of Francis Bacon (1561–1626) who by his writings, and especially by his 'Novum Organum,' elaborated in detail a method of research, the principles of which had been laid down by his predecessors.

From the overturning of the authority of Aristotle and the laying down of a secure basis for the advancement of knowledge, it was but a step to the inauguration of organized research, the aspect of the question to which I wish to invite your attention somewhat more in detail.

The chief agencies of modern organized research are (1) the learned societies and (2) the universities. The former receive and publish research papers; the latter superintend and direct investigators and publish results. To these should properly be added the various journals which have been established and carried on by private effort. It is a significant fact that the establishment of modern learned societies coincides closely in time with the Renaissance movement. Telesio, mentioned above, established one of the earliest mathematico-physical societies—the Academy of Cosenza. Other Italian societies of similar scope were founded in Rome in 1603, in

Florence in 1657, and the Royal Society of London dates from 1660 or earlier. Organized research in universities was of slower growth. In them the mediæval spirit was tenacious of life, and it was only in the nineteenth century, in Germany, at the close of the Napoleonic wars, that research, not only in natural philosophy, but in the whole field of knowledge, became the basis of the German educational system, and I might remark, without going into details, that the university systems of France and the other principal countries of Europe, with the exception of Great Britain, are in the main parallel with that of Germany, although not so consistently elaborated. To understand then what organized university research means in the fullest development which it has hitherto attained, let us turn our attention a little to Germany, of the educational system of which it forms an essential part.

We are so subject to the authority of words that it is difficult for us to realize that the organization called a university in Germany is almost entirely different in scope and object from the institution which we so designate in this country. Hitherto, at least in England and Canada, the function of the university has mainly been to impart a general and liberal education, continuing and completing the beginning already made in the secondary school. Speaking generally, I may say that under the German system the work of our secondary schools and universities combined is performed by the gymnasium, the nine or ten years' training of which leaves the young man of nineteen or twenty years of age with a much better liberal education than that possessed by the average graduate in arts of an English, Canadian or American university. How this is accomplished it is not my purpose here to explain. There is no doubt, however, as to the fact, which is substantiated both by the nature of the curriculum of the gymnasium and by the testimony of those familiar with both systems. In this connection I recall the observation made to me on one occasion by a professor here, himself a wrangler of high standing in Cambridge, who remarked that it was always a mystery to him how the German gymnasiums attained such extraordinary results, results which, he added, it would be hopeless to expect in England, while on the other hand I have more than once heard German professors express surprise at the meager equipment of university graduates from America.

It is upon this substantial preliminary training that the work of the German university proper is based. Up to this point the young man has been a 'learner'; on entering the university he becomes a 'student.' This distinction, expressed by the German words 'lernen' and 'studieren,' marks the difference between gymnasium and university—the acquisition of knowledge under the teacher in one, the independent research under the guidance of the professor in the other.

The typical German university possesses the four faculties of theology, law, medicine and philosophy. The scope of the first three is evident from their designation, and with them we are not at present immediately concerned. The faculty of philosophy embraces the subjects which we include as university studies, under the head of arts and science. It is the most important of the four, the professors in it sometimes outnumbering those of all other faculties combined. The ultimate object of both professors and students is the advancement of knowledge and the independence with which research is conducted is well expressed by the two words 'Lehrfreiheit' and 'Lernfreiheit'—the freedom of the professor as to what he teaches and the freedom of the student to select his special line of research. Some idea of the extent of this work may be formed from the number of universities in Germany, 21 in all, and from the fact that the aggregate number of matriculated students exceeds 12,000, in addition to non-matriculated students, who are also numbered by thousands, while the philosophical faculty at Berlin and Leipzig in 1901–2 numbered, respectively, 207 and 120. To the 21 universities mentioned should be added the nine technische Hochschulen which have now the right to confer the doctor's degree in the applied sciences.

It is impossible to exaggerate the enthusiasm which prevails among both professors and students in their common object, and this enthusiasm is increased by legitimate emulation. The reputation of a university depends upon the progress made by its professors, the reputation of a professor upon the progress made in his department. Hence a student may be attracted from one university to another—which is allowable under the system—may choose to follow the lectures of the professor, ordinary or extraordinary, or even those of the privat-docent in his own particular line of work. Under such a system and under such stimulating conditions it is evident that both professors and students must take their work seriously, with the result that the combined effort of a vast number of the best minds in the country is concentrated on the advancement of all the principal branches of knowledge. With regard to the research work done by the student and without which the degree of Ph.D. is not conferred, it may be objected that much of it is not important and sometimes very trivial. It may be said, however, that it must all stand the test of publication after being approved by the professor, so that its value may at once be estimated by the learned world, and the scholastic standing of professor and student rated accordingly.

The place and importance of research in the German system is further indicated by the fact that even teachers in the gymnasium devote themselves to such work, their papers being published in the annual reports of their institutions. With such respect is the ability for research regarded that the publication of a paper of this kind may lead directly to a professorship in the university, as was the case, for instance, in the appointment of Weierstrass, the celebrated mathematician.

Let us now turn our attention for a few moments to the British university system. An extended description is unnecessary, since we are all familiar with the working of British universities themselves, or with the Canadian or American development of the original British type. Hence it may suffice if I contrast briefly the British and German systems in some of their essential features.

In the organization of the German university research has been shown to be a fundamental principle; in the British university it is as yet incidental or of sporadic manifestation. I do not of course ignore the very important contributions which have been made by British scholars to the advancement of learning, but it is worthy of note that the credit for their splendid achievements is rather due to the individuals themselves than to the universities with which many of them were connected. The British university is not primarily an institution for research. In its function of providing the higher grades of a liberal education the proper comparison is with the upper classes of the German gymnasium, not with the German university proper. True, we find in some of the British universities a specialization in certain subjects, *e. g.*, in honor classics and mathematics at Oxford and Cambridge leading to higher work than that attempted in the gymnasium; but however advanced the studies may be, there is rarely any attempt to guide the English undergraduate in the direction of research. Reading and examinations are the academic watchwords, and to the great mass of students and tutors the field of research is a terra incognita.

The attitude of the British nation has been hitherto largely that of indifference towards organized research, and this has been true not only of the general public, but also of those engaged in academic administration. There has existed a deep-seated conviction, born perhaps of reiterated assertion, that the British university system is superior to that of Germany or any other country, and as near perfection as may well be. We are not concerned just here with the discussion of the merits of the system, which are undoubtedly many and great, but we must admit that the attitude of self-satisfaction which has prevailed, combined with the ignoring of other ideals, is at least unphilosophic. In the midst of such an atmosphere it is not surprising that the development of a true Renaissance spirit has been somewhat tardy.

But the British nation is on the eve of an awakening, an awakening which has already taken place among certain leaders of thought. The fact is dawning upon the British mind that some vital connection really does exist between national progress and scientific discovery, and that the latter should be fostered in connection with the higher institutions of learning. Under the conviction that British commercial supremacy will be seriously threatened unless foreign, and especially German, scientific methods are adopted, universities of more modern type than Oxford and Cambridge, and also technical colleges, have been established. Such institutions no doubt fill a long-felt want, but they do not go to the root of the matter. On the academic side they are but a modification of the older type; on the technical side they contemplate, not the discovery of new truth, but the application of what is already known. The spirit of research is lacking, and without it no expenditure of money, no raising of examination standards for mere acquirement, will actually increase the capital account of national knowledge.

It is perhaps owing in part to the general awakening already mentioned that a rudimentary scheme of research has been recently introduced in the University of Cambridge, where students pursuing original investigations are placed on the same level as the ordinary undergraduate and may obtain the B.A. degree as a reward for work of this kind. Notwithstanding the lack of more substantial encouragement a number of students have entered these courses, being attracted by the reputation of certain professors who are themselves zealously engaged in the prosecution of research. The number of such students, however, is relatively small, nor can it be said that the movement has become general, although other universities are beginning to do something in this direction, but it may perhaps prove to be the germ of a more complete organization in the future.

The policy of the universities of the United States regarding this matter is in marked contrast with the indecision and conservatism which prevail in the mother country. The type of mind which has been developed in the century and a quarter of separate national existence is one of great vigor and originality; but these qualities have for the most part been turned aside by the circumstances of a new country from abstract investigations. Research after the almighty dollar by the nearest short-cut has been, and perhaps still is, regarded as the chief national characteristic of our American cousins, and in this pursuit they have displayed a genius for concrete research in mechanical invention and an ability for commercial and industrial enterprise which have been an object of wonder, and latterly of anxiety to other nations. During the first hundred years of national existence the university of the gymnasium type which has been inherited from England continued to develop and expand in the United States. Suddenly, however, almost exactly twenty-five years ago, a remarkable modification was introduced. The year 1877 marks an epoch in the establishment of the Johns Hopkins University, with research courses leading to the degree of Ph.D. as an addition to the usual undergraduate work; in other words, a grafting of the German university system upon the original stock. It is proper to state that even before that date research work had been prosecuted incidentally in some of the older existing universities. On consideration of the circumstances it is not difficult to account for this new departure. The movement was undoubtedly due to the influence of American students who had gone to Germany for special studies. This migration to and fro had been going on for some time before the founding of Johns Hopkins and still continues, the number of such students gradually increasing from 77 in 1860 to an average of about 400 annually during the last decade. The new university experiment was a success from the first. The scheme was carried out on such a high plane that large numbers of able and zealous students were attracted from all parts of the continent by the facilities for higher study and by the scholarships and fellowships which formed part of the scheme. The appointment of graduates of Johns Hopkins to positions in other universities and their success as teachers and investigators have led to a widespread demand for professors who have proved their capacity for original work.

Since 1877 many other universities, including the best of those already in operation, as well as new foundations, have added a graduate department leading to the Ph.D. degree, although none of these, with the exception of Clark University, has made the prosecution of research the sole business of the university. Some idea of the rapid progress of this movement may be gathered from the fact that the numbers pursuing graduate studies in the universities of the United States have increased from eight, in 1850, to 399 in 1875, and to about 6,000 in 1902. We must conclude from these figures, I think, either that the national mind discerns some ultimate advantage in the cultivation of abstract science, or that, for once, it has been mysteriously diverted from the pursuit of the 'main chance.' It is surely significant that a practical philanthropist like Mr. Carnegie has recently bestowed the magnificent endowment of $10,000,000 for the establishment of an institution to be devoted solely to the promotion of research.

As to the ultimate scientific value of what has already been accomplished in the way of research under the influence of this recent movement, there is room for a qualifying remark. It must be remembered that much of the graduate work referred to does not mean actual research, the course for the Ph.D. in many cases being no higher than the honor B.A. course with us. What is required to remedy this unsatisfactory condition is that the Ph.D. be given only on the German plan, and that the main test therefor, a research, be published. When this condition becomes absolute there will be material for the world's judgment as to the amount and quality of the contribution to the advancement of knowledge.

Organized research in Canadian universities, as a definite system, can scarcely be said to exist as yet, although within the last decade certain beginnings have been made which indicate a movement in that direction. Canada, like the United States, has derived its university ideals from Great Britain. Some of the original faculties of our universities were a transplantation, so to speak, of groups of scholars from Britain, who brought with them intact the traditions in which they themselves had been nurtured, so that we received by direct importation scarcely more than fifty years ago a system which in the United States had been developing in its own way since the founding of Harvard in 1636. I cannot better illustrate the attitude towards research of many of these academic pioneers than by quoting the remark made by an English professor—himself a classical scholar—on an occasion so comparatively recent as the establishment of the physical laboratory in the University of Toronto. 'Why go to the expense,' said he 'of purchasing this elaborate equipment until the physicists have made an end of making discoveries?'

In the interval the idea of research has made gratifying progress among the well-informed. Probably few scholars could now be found in Canada who would put their objections so naïvely as my classical friend. This progress has come in part from a natural process of evolution within ourselves, and in part also from external influences, notably that of Germany and the United States. Many of our graduates have pursued courses of study in Germany and have brought back with them the German ideal. Besides, such is the geographical position of Canada with regard to the United States, and such the community of social and intellectual life, that the universities of these two countries must inevitably develop along parallel lines; and hence, if for no other reason, we may look forward to the gradual extension here of the research movement which is already so widespread in the neighboring republic.

That a natural and healthy demand for this kind of work already exists may, I think, be inferred from the success which has attached to the recent establishment of the doctorate degrees in certain universities, but still more perhaps from the fact that for some years it has been customary in some cases to direct honor students in the final year of the B.A. course to the work of research. In illustration of what has been accomplished in this way I may state that some of the papers presented in Section III. at the present meeting have been prepared by undergraduates in arts in the University of Toronto. But whatever may be the ultimate outcome of the research movement with us, permit me to repeat what I have already said in another connection, namely, that the Ph.D. should not be given without the presentation of a satisfactory thesis, and that such research should be published before the degree is awarded.

I have confined my remarks up to this point almost wholly to the historical aspect of the question, but it will perhaps not be out of place for me to point out in conclusion some of the advantages which in my opinion are connected with the pursuit of university research.

Let us consider first the stimulating effect upon the individuals and institutions concerned. Among those who are affected by this stimulus should first be named the professor. Dr. Samuel Johnson was wont to compare accumulated knowledge to a heap of ice lying exposed to the summer sun, the bulk of which could not be maintained without constant replenishment. Continuing the figure, we can readily imagine that the professor's fund of knowledge which is ample enough for the class-room teaching of immature minds might shrink and trickle away until little is left but the sawdust which we usually associate with the preservation of that commodity. Under the stimulus of research this is impossible, for research into the new implies a full and minute mastery of that branch of knowledge in which the research is being conducted. Hence if no other advantage resulted a good case might be made out along this line of argument.

This stimulus to the professor would react with increased force upon the student. It was a favorite saying of a certain celebrated artist that those who follow after others rarely outstrip them. To hold up before the student either by theory or practice solely the ideal of acquiring what has already been learned is mediævalism pure and simple; it is to teach him to creep where he might walk upright and alone; it is to rob him in part of that intellectual birthright of independent thought which is the inheritance of every man, at least since the Renaissance. It is sometimes objected that the results attained by research students are often trivial or futile. I am disposed, however, to agree with a remark made by one of George Eliot's characters: "Failure after long perseverance is much grander (and I would say parenthetically more useful) than never to have a striving good enough to be called a failure." It is sometimes also urged that research in the immature student leads to superficiality and conceit. I cannot but think this fear ill-grounded. It has been proved on the contrary that nothing will so quickly ripen and enlarge preliminary knowledge and so effectually extinguish presumption as the hand-to-hand struggle with some special problem in the department of study in which the student is already proficient.

Apart from the professor and student, the first effect of the inauguration of research work in our universities, if of the genuine stamp, will be felt upon the teaching profession of the country as a whole. Assuming an educated and interested public opinion, the premium so long placed upon memorized knowledge will disappear, and a change in the principle of selection of teachers both in universities and secondary schools will result. The time will have gone by, let us hope, when Huxley will be passed over, as was the case fifty years ago, when his candidature for a chair in the Provincial University was unsuccessful.

We come finally to the effect of research upon the national life. Canada, it is true, is barely on the threshold of national existence, rich, however, in natural resources, and richer still in the physical, moral and intellectual qualities of its people. Its future as a nation will depend largely upon the aggregate of intellectual effort of its population. In this sense truly knowledge is power. The time has surely come when we should cease to take all our knowledge at second hand from abroad, and when we should do some original thinking suitable to our own circumstances. Under the term original thinking I do not include merely the researches of the laboratory, for the spirit of research which inspires the chemist or the philologist is one with that creative faculty which moves the poet and the novelist, a spirit which guides all contemporary movements in literature, science and art. For the development of this spirit of originality the country must look primarily to its universities, for on them depends ultimately the whole intellectual life of the people. The time is approaching, if indeed it has not already arrived, when the research university must be regarded as the only university, and the task is incumbent upon those in authority of elaborating a university system not necessarily in imitation of those of other lands, but one which shall have proper regard to the importance of this new factor as well as to the past and future of our country.

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SECTION OF THE GEOLOGICAL AND BIOLOGICAL SCIENCES.

THE meeting of the Royal Society of Canada at Toronto, May 26–29, was one of great interest, especially so in regard to the value and importance of the papers and discussions in Sections 3 and 4, whose particular province is the study of the natural and applied sciences. The meetings were held within the precincts of the University of Toronto, whose ample halls and well-equipped laboratories were placed freely at the disposal of the Society. The beautiful 'Queen City' of Canada was bright with blossoms and the fresh-tinted foliage of the trees which so abundantly adorn her broad avenues. A generous welcome was extended by her citizens to the fellows and delegates of the Society who represented Canada from Halifax to Winnipeg. The meeting lacked the genial presence and active inspiration of Sir John Bourinot, the honorary Secretary, whose serious illness was a matter of deep regret to all. His rare executive ability and tact, and the control which he has so wisely exercised in guiding the Society during the twenty perilous years of its existence, are shown in the position which it occupies to-day. The stimulus which it has given to original research and the world-wide interest which the publication of its proceedings has awakened have been in a large measure due to his fostering care and unremitting industry.

Among the recommendations contained in the report of the honorary Secretary were the following: That everything possible should be done to preserve historical sites in Canada; that systematic ethnological work should be carried on; that the Canadian people should cooperate with the people of the United States and Mexico in determining the ninety-eighth meridian; and that the operations of the Government Marine Station of Biology should be continued and increased. During the meeting committees considered several of these recommendations and emphasized their importance in subsequent reports.

The address of the president, Dr. Loudon, of Toronto University, on 'Research in Universities,' was a careful presentation of the subject, showing what has been done—and what has not been done—in German, English, United States and Canadian Universities.

In Section 4 a large proportion of the papers read embraced topics on the geology of various sections of eastern Canada. One of the most important of these was a paper on the sites of ancient volcanic activity in the neighborhood of the St. Lawrence Valley, by Professor Frank D. Adams, of McGill University. After an introductory reference to the recent outbreak on the island of Martinique, Dr. Adams gave an account of the general geological structure and petrographical character of the series of ancient volcanic hills which rise from the Paleozoic plain to the east of Montreal. These are eight in number and are arranged along two parallel and almost straight lines, evidently ancient lines of weakness. Those situated on the most northerly of these lines, commencing from Mount Royal on the west and going east, are Mount Royal, Montarville, Belœil, Rougemont, Yamaska and Shefford. The distance from Mount Royal to Shefford Mountain is fifty miles. The mountains on the southern line are two in number—Brome Mountain and Mount Johnson. Of these hills Mount Royal (Mons Regius), at the foot of which the city of Montreal is situated, is the best known and may be taken as the type of the series. Dr. Adams proposes for the group the name of the *Monteregian Hills*. These hills form a most remarkable petrographical province, consisting of a dual series of alkali-rich rocks, represented on one hand by the essexitetheralite series, and on the other by the pulaskite and nepheline-syenite series. There are also a great number of dyke rocks of consanguineous types, bostonites, tinguaites, monchiquites, fonchites, camptonites, alnoites, etc. The hills are erosion remnants of volcanoes or laccolites, dating back probably to Neo-Paleozoic times. Dresser, who has recently studied Shefford and Brome, considers them to be partially uncovered laccolites. About Mount Royal, on the other hand, a few remnants of the ancient tufa pile remain, showing that the molten material at this point found a passage to the surface.

A detailed description of Mount Johnson was given. This very interesting occurrence is 875 feet high and nearly circular in cross section, being a little over half a mile in average diameter at the base. It is a typical neck or pipe, consisting of theralite in the center, which passes gradually over into pulaskite on going outward to the periphery. It is situated about seven miles from the town of St. Johns, P. Q.

Dr. G. F. Matthew discussed some geological questions arising out of his studies of the Cambrian faunas of eastern Canada, especially the initial faunas of this system, to the examination of which he has devoted himself with great industry for many years.

Six genera (and subgenera) of brachiopods are found at the very base of the system; and it is seen that there is a gradual, though no very marked, increase in size of these forms when traced through the basal Cambrian faunas. The genera (and subgenera) found were—of Atremata—*Leptobolus, Obolus, Lingulepis* and *Lingulella*—of Neotremata, *Acrothyra* and *Acrotreta*. The first of these two was the only genus that exhibited no increase in size as time went on, and it was found only in the basal Cambrian (below the Paradoxides zone).

The increase of bulk of the individuals of these old genera during this Geological Age is in accordance with the development in this respect of higher forms of life, but less noticeable in degree.

Another subject taken up by Dr. Matthew was the development of the Canadian Oboli, as shown in impressions of the muscle scars, of the vascular trunks, and by the surface ornamentation of the shells.

It was stated that in the first determination of these shells we must often depend on the form, as this is the most obvious, and sometimes the only, available character.

But further knowledge of the nature of the species, as shown by the internal markings, etc., has proved that there are several independent lines of development of the Oboloid shells, and that the typical *Obolus* (*O. Apollonis*) is nearer in structure to the typical *Lingulella* (*L. Davisii*) than to these earlier species, which outwardly, as regards the form, are indistinguishable from *Obolus*.

Of these shells one type belongs to the Lower Etcheminian fauna, one to the Upper Etcheminian fauna, two to the Protolemus fauna (all these are below Paradoxides), one to the Peltura fauna, and one to that of *Dictyonema* (*D. flabelliformis*).

Another subject discussed in these notes was the evidence of the direction of the migration which brought these early faunas to the Atlantic region of Canada. It was shown that during the time when the Upper Etcheminian fauna prevailed in Atlantic Canada, there was a steady current setting along the then existing shores to the northeast. This is shown by the orientation of the valves of the inarticulate brachiopoda, the apices of the valves being directed to the southwest. Hence it is inferred that the migration of the fauna was from that direction. This is the reverse of the conditions shown by R. Rudemann to have prevailed in northern New York during the time of the Utica state; the direction of the current there and then being shown by the attitude of colonies of graptolites, which are turned in a southwest direction.

Papers on local geology of Ontario and New Brunswick were presented by Professor H. S. Coleman, of Toronto University, and by Professor L. W. Bailey, of the University of New Brunswick.

An afternoon was spent by the geologists with Professor Coleman in examining the interglacial deposits at Scarborough Heights on the northern shore of Lake Ontario, near Toronto.

The papers by Professor D. P. Penhallow, of McGill University, on Cretaceous and Tertiary plants, possessed special interest from the fact that they represented a continuation of the paleobotanical work carried on for so many years by the late Sir William Dawson. Among the material collected by the latter were many plants which, at the time of his death, had not been studied, or if so, but very casually, and Professor Penhallow has since that time devoted special attention to their critical examination. Plants from three localities form the subject of the present papers—Cretaceous plants from Vancouver and Queen Charlotte Islands, Tertiary plants from the Red Deer River, N. W. T., and also from the Horse-fly River, B. C. In each case the plants confirm previous testimony as to the age of the formation. From the Lower Cretaceous of Skidegate Inlet, Queen Charlotte Islands, there were obtained fragments of a fern which permitted the almost complete restoration of an *Osmunda* closely allied in most respects to the type of *O. Claytoniana*, though probably about seven times as large. In a few respects the internal structure showed it to approach the type of *Todea*, so that it may probably be taken as representing an intermediate form. *Ginkgo pusilla* and *Sequoia Langsdorfi*, previously known only through foliage and fruit, have now been recognized through the structure of the stem. In the collection from the Red Deer River, two new forms appear, and are unquestionably to be referred to the existing genera *Clintonia* and *Maianthemum*, as the foliage is identical in all essential respects. In the Miocene of the Horse-fly River, there was found the wood of a *Pseudotsuga*, which appears to be the first material of the kind recorded. The remainder of the material embraces well-known species of the Cretaceous and Tertiary formations.

Dr. Wm. Saunders, Director of the Central Experimental Farm, Ottawa, gave a striking illustration of the progress that is being made in introducing fruit plants into the Northwest. A hardy Siberian apple, which bears a fruit little larger than an Ontario haw, had been crossed with the Ontario apple. The result was the production of a fruit about an inch in diameter. About four hundred of these had been crossed, and last year they had thirty trees, and this year will have about seventy, bearing fruit. They retain the hardiness of the Siberian apple, but the more they are crossed the nearer the product comes to the Ontario fruit. Results of experiments in crossing English and American currants and gooseberries, plums and cherries with hardier varieties of these plants have not in all cases been successful, but enough has been accomplished to show that hardy varieties of Ontario fruits may be produced in the Canadian Northwest, which in addition to becoming the greatest wheat-producing region in the world, will also be known for its fruit products.

A paper on the botany of northern New Brunswick was read by Dr. G. U. Hay, in which was noted the large number of boreal species found on the Restigouche River in close proximity to those of a more southern or New England type found along that river and on the upper St. John.

Dr. A. H. MacKay, Superintendent of Education for Nova Scotia, gave the results of a series of phenological observations carried on by the teachers and pupils of the schools in that province, one important object of which is the encouragement and stimulus given to 'nature study.'

The results of a series of interesting experiments, noting the behavior of blind animals, were given by Professor Wesley Mills, of McGill University; and Professor B. J. Harrington, of the same University, read an appreciative sketch of the life and work of the late Dr. Geo. M. Dawson.

The officers of the Royal Society for the current year are:

President, Sir James Grant, Ottawa; *Vice-President*, Lt.-Col. G. T. Dennison, Toronto; *Secretary*, Sir John Bourinot, Ottawa; *Treasurer*, Dr. Jas. Fletcher, Ottawa.

An excursion to Niagara Falls, of which about thirty members of the Society—chiefly scientists—availed themselves, was given by the citizens of Toronto. The party visited the works of the Canadian Power Company, whose guests they were for a day; and also were allowed to inspect the plant of the Niagara Falls Power Company on the American side, a favor which was greatly appreciated. G. U. Hay.

St. John, N. B.

SECTION OF THE MATHEMATICAL, PHYSICAL AND CHEMICAL SCIENCES.

By special invitation the annual meeting of the Royal Society of Canada was held at Toronto, in the buildings of the University, on May 26–29. The sessions were largely attended, and the cool weather contributed to the success of the excursion to Niagara Falls (where the members were guests of the Canadian Niagara Power Co.) and of the trip along the lake shore to examine the interglacial deposits east of Scarborough.

The third Section (Mathematical, Physical and Chemical Sciences) met in the large physical lecture room, the President, Professor R. F. Ruttan, M.D., C.M., in the chair. 'Dalton and the Theory of Atoms' formed the subject of the President's address, and the reading of papers was diversified by a debate on the 'Existence of Particles Smaller than Atoms.' Professor Rutherford gave an account of the growth of the electron theory, and showed how the masses and velocities assigned to the hypothetical 'carriers' had been arrived at. Dr. J. C. McLennan exhibited a number of experiments illustrative of the facts on which the theory is based. Professor Lash Miller discussed the advantages and disadvantages of corpuscular theories in general, showing that they were impossible to prove and nearly as impossible to disprove, and Professor Cox spoke of the recent extension of the theory to cosmical phenomena. Professors Goodwin, Baker, Walker and Ruttan also took part in an animated discussion.

At the close of the sessions, Dr. J. C. Glashan, of Ottawa, and Professor H. T. Barnes, of Montreal, were elected members of the Section, and Professor M. Berthelot, of Paris, a corresponding member of the Society.

The following papers were read before Section 3:

MATHEMATICS.

On the Correlation of the Curve of the Second Order and the Sheaf of Rays of the Second Order in Geometry of Position: Professor A. Baker.

Beginning with the curve of the second order, which may be considered to be defined by five points, tangents are constructed at these five points; and viewing the tangents as the basis of a sheaf of rays of the second order, the original five points are shown to be points of contact. Reverting to the original five points, construction for a sixth point is made, and the tangent at that sixth point is obtained; this tangent is shown to belong to the sheaf of rays of the second order furnished by the five original tangents. It was also shown that the curve is uniquely determined whatever two points be selected as radiant points; and an analogous proposition was established with regard to the sheaf of rays.

On the Matrix Analysis of Quantics and Their Concomitants: Dr. J. C. Glashan.

A development of the consequences of applying to the operand as well as to the operator the notation of matrices.

Forms for the Abelian Integrals of the Three Kinds: Dr. J. C. Fields.

A Theorem Regarding Determinants with Polynomial Elements: Professor W. H. Metzler.

Generalization of a theorem of Muir's (*Messenger of Math.*, No. 153, 1884) omitting the restriction that the number of terms in each element of the determinant must be greater than the number of constituents in a row.

PHYSICS.

On the Use of the Wheatstone Stereoscope in Photographic Surveying: Capt. E. Deville.

Description of an instrument proposed for drawing a topographical plan by mechanical means from a pair of stereoscopic photographs.

The Neutral Axis of Beams Under Transverse Loads: Professor H. T. Bovey.

Experiments with a new Extensometer. The assumptions of the text-books are verified for a cast-steel beam of square cross section, but not for a T-beam.

Soli-Lunar Time: Mr. G. W. McCready.

The average date of the first full moon in every decade for 4,000 years.

The Potential Difference Required to Produce Discharge in Air and Other Gases: Mr. W. R. Carr.

Experiments carried out under the direction of Dr. J. C. McLennan, with air, hydrogen, carbon dioxide, acetylene, hydrogen sulphide, nitrous oxide, sulphur dioxide and oxygen. The law governing electric discharges between parallel plates, in a uniform field, in any gas, for pressures at and below the critical pressures, is that which Paschen found to hold with spherical electrodes for high pressures, viz., that with a given spark potential, the pressures at which discharge occurs is inversely proportional to the distance between the electrodes.

The values of the spark potentials are not influenced by the material or size of the electrodes; and the minimum spark potential is independent of the pressure and of the distance between the electrodes, always provided that the discharge is compelled to pass in a uniform field.

Penetrating Rays from Radium: Professor E. Rutherford.

Experiments showing the passage of the rays through from eight to ten inches of iron. The ionization produced by the rays after emerging from the iron shows that they must be regarded as consisting of negatively charged particles. Photographic methods are being applied to determine the magnetic deflection of the rays.

Radio-active Emanations from Thorium and Radium: Professor E. Rutherford.

Résumé of a number of recent experiments by the author.

Excited Radio-activity from the Atmosphere: Mr. S. J. Allan.

The amount of the radio-activity is independent of the material of the negatively electrified wire. After exposure, the intensity of the radiation fell to one half in fifty minutes; while that excited by thorium fell to one half in eleven hours.

Radio-activity Induced in Salts by Cathode Rays and by the Discharge Rays from an Electric Spark: Mr. W. R. Carr.

Experiments carried out under the direction of Dr. J. C. McLennan. Radioactivity is excited in certain salts by Röntgen rays, as well as by cathode rays, and by the discharge rays from an electric spark.

Radio-activity Induced in Substances Exposed to the Action of Atmospheric Air: Mr. R. M. Stewart.

Experiments carried out under the direction of Dr. J. C. McLennan. The rate of loss of induced radio-activity depends on the potential at which the wire was exposed, rather than on the time of exposure.

On the Absolute Value of the Mechanical Equivalent of Heat: Professor H. T. Barnes.

The heat required to raise the temperature of one gram of water from 15.5° to 16.5° C. is equal to 4.1832×10^7 ergs. In gravitation units this becomes 426.60 kilogrammeters, or 777.58 foot-pounds.

On the Density of Ice: Professor H. T. Barnes and Mr. H. L. Cooke.

Historical résumé and criticism. New experiments. Probable cause of variation in density. Bibliography.

The Variation in the Density of Ice: Mr. H. L. Cooke.

The variation is ascribed to mechanical strains due to unequal expansion and contraction.

The Fall of Potential Method as Applied to the Measurement of the Resistance of an Electrolyte in Motion: Professor H. T. Barnes and Mr. J. G. W. Johnson.

Measurements of the conductivity of solutions of magnesium chloride. During the measurements the solution flowed slowly through the cell; the velocity of flow did not affect the results.

CHEMISTRY.

A Modification of Victor Meyer's Vapor Density Apparatus: Professor B. J. Harrington.

The long stem is bent into a series of loops, and a second opening is provided for introducing the substance into the bulb. The apparatus is compact and convenient.

On the Determination of Moisture in Honey: Mr. F. T. Shutt.

The honey is dried in a current of air at a constant temperature below 100° C., and the loss determined.

An Improved Method of Producing Concentrated Manure from Human Refuse: Mr. T. Macfarlane.

Description of an odorless moss-closet. When properly used, the quantity of absorbent is not more than one twentieth of the resulting manure.

Experimental Investigation of the Conditions Determining the Oxidation of Ferrous Chloride: Mr. A. McGill.

Ferrous chloride can be decomposed by oxygen in such a way as to yield uniformly from 75 to 85 per cent. of its chlorine in available form, and from 10 to 20 per cent. as hydrochloric acid.

Analysis of Anthraxolite from Hudson's Bay: Professor W. H. Ellis.

A sample brought by Mr. G. R. Mickle from Long Island, Hudson's Bay, contained 0.54 per cent. ash. The dry ash-free mineral gave: carbon, 96.54; hydrogen, 1.33.

Abnormal Results in the Hydrolysis of Amygdaline: Professor J. W. WALKER and Mr. W. S. HUTCHINSON.

Boiled with dilute acids amygdaline is resolved into glucose, hydrocyanic acid and benzaldehyde. Heated with concentrated hydrochloric acid it yields a humus substance and dextro-mandelic acid. Boiled with dilute alkalies it yields ammonia and amygdalinic acid, which on hydrolysis with dilute hydrochloric acid gives inactive mandelic acid.

Oudemann's Law, and the Influence of Dilution on the Molecular Rotation of Mandelic Acid and its Salts: Professor J. W. WALKER.

Strong indications were found that the law was not confirmed in very dilute solutions, where it ought to hold most rigidly.

Specific Heats of Organic Liquids, and Their Heats of Solution in Organic Solvents: Professor J. W. WALKER and Dr. J. HENDERSON.

An electric method is employed for determining the specific heat; a close connection is indicated between the degree of association of a liquid and its heat of solution in an unassociated solvent.

The Specific Heat of Water of Crystallization: Mr. N. N. EVANS.

The solid, finely ground, is suspended in a suitable liquid in the calorimeter, and a measured quantity of heat is introduced electrically. A range of four degrees is sufficient for accurate results.

Researches in Physical Chemistry Carried Out in the University of Toronto During the Past Year. Communicated by Professor W. LASH MILLER.

Under this head the following eight papers were introduced.

Application of Polarimetry to the Determination of Tartaric Acid in Commercial Products: Professor E. KENRICK and Dr. F. B. KENRICK.

The method is based on the addition of ammonium molybdate to the material to be analyzed; it is applicable in the presence of alum, iron, sugar, etc.

The Sulphates of Bismuth: Dr. F. B. ALLAN.

An application of the phase rule. The following salts were identified: $Bi_2O_3.4SO_3$, $Bi_2O_3.2SO_3.2\frac{1}{2}H_2O$, $Bi_2O_3.SO_3$. (*Am. Chem. Jour.*, 27, 284.)

The Influence of Iron Salts on the Rate of Reaction Between Chromic Acid and Iodides: Miss C. C. BENSON.

The rate of liberation of iodine as a function of the concentrations of the reacting substances; and the rate of oxidation of ferrous salt by chromic acid in presence and absence of iodide.

The Reaction Between Stannous Chloride and Potash: Mr. C. M. CARSON.

The results are in conflict with those of Ditte.

The Rate of Oxidation of Iron Salts by Oxygen: Mr. J. W. McBAIN.

Experiments carried out under the direction of Dr. F. B. Kenrick. (*Jour. Phys. Chem.*, V., 623.)

The Rate of Reaction in Solutions Containing Potassium Chlorate, Potassium Iodide, and Hydrochloric Acid: Mr. W. C. BRAY.

Experiments showing that two reactions of the fourth order occur simultaneously. Schlundt's results are recalculated.

The Rate of the Reaction Between Arsenious Acid and Iodine in Acid Solution; the Rate of the Reverse Reaction; and the Equilibrium Between Them: Mr. J. R. ROEBUCK.

The 'Thiosulphate Method' of Measuring the Rate of Oxidation of Iodides: Mr. J. M. Bell.

The method was introduced by Harcourt, using sodium peroxide as oxidizing agent; it is not applicable when chloric acid, chromic acid, or ferric salts are employed. Schükarew's assumptions (*Zeit. Phys. Chem.*, XXXVIII., 357) are not justifiable.

W. LASH MILLER,
Secretary pro tem.

PROBLEMS IN THE CHEMISTRY AND TOXICOLOGY OF PLANT SUBSTANCES.*

THE organic chemistry of to-day is the chemistry of the approximately 50,000 carbon compounds, enumerated in the recent edition of Beilstein's 'Handbuch der Organischen Chemie.' Most of these compounds are the fruit of research in purely synthetic chemistry, enormously stimulated, as it has been of late, by the growth of new, far-reaching conceptions in physical chemistry, and, especially, by the substantial rewards of the chemical industries which have arisen as a result of these investigations; a considerable number of the compounds enumerated have, however, been isolated from plants. Some of this work of plant investigation has been adequately rewarded, but as a rule it has only awakened a greater esteem for the investigator. The larger returns of synthetic chemistry are still enticing most of our best organic chemists into its fold, but its phenomenal success in producing substances such as urea, sugar and several plant alkaloids and glucosides hitherto known only as the products or educts of life, has stimulated inquiry not only into the chemical nature of cell life, but also into the chemistry of the dead principles that may be isolated from these cells. Mother Nature is, however, a very cunning and crafty chemist, with a keen understanding of all of the requirements of cell growth under astonishingly varied conditions of environment, and especially with an eye for the protection and perpetuation of her multitudinous progeny against the ravages of parasites, or of man and beast, she has built up a very great variety of compounds, the properties and methods of formation of many of which she still holds secret. Many of these compounds, especially those primarily designed for the protection of the plant, react physiologically on diverse forms of animal life, and are, therefore, recognized by the medical fraternity and by chemists as 'active principles.' All which produce disturbances of the normal functions of an animal when introduced into its economy are, according to Hermann's well-known textbook on pharmacology, called poisons.

It is a sad commentary on the present state of our knowledge of plant chemistry that all we know chemically about the active principles of many plants is that the plants themselves are poisonous. Chemistry might be excused for her lack of interest in examining such physiologically-inert bodies as cellulose and chlorophyll, but it would seem that the plant poisons should at once challenge attention simply on account of their great tendency to react chemically, as they do with some one or more of the essential constituents of the animal organism. The dreaded effects upon man of such plants as the 'deadly upas,' the 'deadly manchineel,' or the common 'poison ivy,' deter many chemists from handling them, and, as shown above, there is little inducement financially for one to enter into such investigations, but the chemist's lack of a knowledge of botany is more frequently the controlling factor in this neglect. Many of the most interesting problems of plant poisoning cannot be conceived either by the chemist or by the botanist alone, but one who is

* Address of the retiring president of the Chemical Society of Washington, April 10, 1902.

constantly looking at these problems from both points of view could not well be thrown into intimate touch with the subject long before many interesting problems would be presented to him for solution. When once conceived these problems are readily susceptible of treatment, either by the chemist or the physiologist alone, or by one or both of them in conjunction with the botanist, the biologist or the pharmacologist. It was with the object of interesting you, as chemists, in this line of work that I was induced to select it as the subject of my discourse on this occasion. No more interesting and self-sufficient life-work could possibly be suggested to a young student starting on his college career than the investigation of plant poisons. As fascinating as a game of chess, the work calls forth, for its most successful treatment, the widest activities of mind and the most skillful handling of finely adjusted instruments. Art and literature lend a peculiar charm to the work, while the warm plaudits of men await him who solves any of the important chemical problems of immunity. This inviting field comes, I maintain, as properly within the scope of plant chemistry as within that of medicine, for disease is simply a disturbance of the natural functions of the animal economy, caused by poisons, many of which are excreted within the affected animal by such low plant organisms as bacteria and perhaps molds. Indeed it has been shown that all of the lesions supposed to be caused by certain living bacteria can be produced by the administration of sterilized filtrates, obtained by passing extracts made from the bacteria through a Pasteur filter.

Plant poisons divide themselves most naturally and most comprehensively according to their plant origin; all attempts at a chemical classification have been incomplete because of our ignorance of the composition and structure of many of the compounds, while the physiological classification is unsatisfactory on account of our ignorance of the chemical composition of the compounds and of their exact mode of action on animal life. Let us inquire into the nature of the parallelism which exists in the grouping of plant poisons, and the grouping of the plants which contain them!

Plants are commonly divided into species, genera and families, and these are grouped into two series—the flowering and the non-flowering plants—the latter being the more simple morphologically. Each of these in turn is grouped into smaller classes. Proceeding from the more simple to the more complex, we have in the non-flowering plants such groups as the bacteria, the diatoms, the molds, the fleshy fungi, the mosses and the ferns, while in the flowering plants we have the monocotyledons with parallel-veined leaves and the dicotyledons with net-veined leaves. This classification is, in general, based on the general morphology of the plant, but in the lower orders, especially in the bacteria, the chemical composition or at least the chemical and physiological reactions which the plant is able to induce are taken into consideration in the differentiation of the species. In many of the subdivisions in the higher groups, however, there is often an apparent chemical basis for classification. It seems just as reasonable to suppose, as van Rijn has shown in his book entitled 'Die Glykoside,' that there should be genetic relationships between the chemical substances represented in any one group of plants, as that there should be morphological relationships. Both results are brought about entirely by the energy of the living cell, a process which is undoubtedly largely chemical in its character, and would seem almost as necessary for a plant to gradually evolve new and therefore closely related chemicals for slight changes in environment, as that it should evolve new and closely related forms for the same purpose. The relationship between the chemical constituents of certain groups of plants cannot, of course, be so apparent as is the morphological relationship, simply because it cannot be determined by inspection alone, as the latter can. If, therefore, our knowledge of plant constituents were sufficiently complete we could perhaps write monographs classifying the different species of plants according to their chemical constituents, as well as we now write monographs based solely on morphology. The same alkaloid is often found exclusively in certain families of plants, but the same family, and even the same species, often contains one or more alkaloids which differ from each other by a few atoms of hydrogen or a few simple organic radicals, or they may differ only in being isomers or polymers. In many of these cases one compound can often be transformed into another by a few simple reactions.

Of the two great classes of plants—the non-flowering and the flowering—the former contain very few active principles, and those which do exist are far more simple than those which are found in the flowering plants. In the bacteria, to be sure, we have highly developed poisonous compounds, the toxalbumins, but aside from these there are few active principles in them. The simpler group of poisonous acids is here more abundant; there are few glucosides and still fewer alkaloids. The most prominent of the latter are ergotine from ergot, and muscarine from the fly fungus (*Amanita muscaria*). There has been an immense amount of study done on the former but its chemical composition is still in a most unsatisfactory condition. Trimethylamine, one of the simplest of the so-called alkaloids of the aliphatic series, is also present in ergot at certain stages of its growth. According to the definition of alkaloids now commonly accepted, however, neither trimethylamine nor muscarine is an alkaloid, this class being restricted to the benzol or aromatic series of compounds. Proceeding still higher in our grouping of plants we find that there are but two conspicuous alkaloids, toxine and ephedrine, in the lowest group of flowering plants, and that, in the many families of the next higher group, the monocotyledons, there is but one family, the Melanthaceæ, which contains more than one or two important alkaloids. In the highest group, however, there is a long list of alkaloids, arranged often in groups, characteristic of the family to which the plants belong. The atropine-like alkaloids of the Solanaceæ; the strychnine-like alkaloids of the Loganiaceæ; the morphine-like alkaloids of the Papaveraceæ; and the quinine-like alkaloids of the Rubiaceæ are the best well-known groups. There is a similar distribution of the glucosides throughout the plant kingdom, but these compounds, being simpler than the alkaloids, are found lower down in the plant scale. It is interesting to note, however, that throughout the whole list of the tremendously abundant family of grasses, one of the lowest families of flowering plants, there are but two glucosides, neither of which is at all well known. One of these is loliin, from the poison darnel, *Lolium temulentum,* while the other, setarian, was isolated from millet so recently as in 1899 by Professor E. F. Ladd, chemist of the Agricultural Experiment Station at Fargo, North Dakota. The grouping of all plant constituents in accordance with their plant classification offers a tempting field of work, but this cannot well be undertaken to advantage until the identity and nature of a great many more plant substances have been determined.

Sohn's 'Dictionary of the Active Principles of Plants' enumerates about 600 substances, all of which are included under the three commonly recognized classes of these bodies, viz., the glucosides, the amaroids or so-called bitter principles, and the alkaloids. These three classes do not, however, include all of the groups of toxic substances which are represented in plants. In addition there are mineral substances, which under certain conditions may be taken up by plants, acids, oils, enzymes and their closely related congeners—the toxalbumins.

Mineral substances very rarely cause poisoning on account of their occurrence in plants, but it has been shown that the presence of lead in a certain grass has led to distinct symptoms of lead poisoning in cows that ate it. An exceedingly important problem suggests itself in this connection and that is the possibility of poisoning from the gradually increasing use of insecticides on fruit trees and on vegetables. It has already been pointed out that plants which have been manured with superphosphates, which frequently contain arsenic, may absorb arsenic into their tissues to such an extent that arsenic poisoning may result from eating them.

The great toxicity of prussic acid is well known. It occurs free in certain plants and in the form of a glucoside in several others, especially in those belonging to the rose and apple families. Oxalic acid is also present in the form of an acid oxalate in many plants. It is extremely poisonous. Crotonoleic acid, from *Croton tiglium*, is still more poisonous, the fatal dose being represented by only .38 of a milligram per kilogram of body weight. Poisonous acids are not so generally looked for in plants as they should be, and it is quite possible that the active principles of some plants, the chemical nature of which is still unknown, are acids. The effect of the common locoweed of the Western States, *Astragalus mollissimus*, has been attributed to loco acid.

The medicinal and therapeutic effects of the vegetable oils are tolerably well known, but it is not commonly recognized that some are poisonous. Among the most powerful of these are the oils of chamomile, cloves, cinnamon, sassafras, savine, rue, hedeoma, and tansy. Many of these are commonly used as flavor and to preserve food, but it is certain that their excessive use might result in serious gastric disorders if not in death. All are useful on account of their being antiseptic, a property which was commonly recognized centuries ago by the Egyptians in embalming bodies. Nutmegs contain a volatile oil which is toxic; two of the nuts proved fatal to a young girl who ate them. The extreme toxicity of toxicodendrol, the non-volatile oil of the common poison ivy, *Rhus radicans*, and poison sumach, *Rhus venenata*, has recently been shown by Dr. Franz Pfaff, of the Harvard Medical School, who proved that the hundredth part of a milligram easily caused a severe dermatitis on many persons, while as little as the thousandth part of a milligram caused severe itching of the skin and half a dozen vesicles on some persons, and localized œdema on others that were more sensitive to its effects.

The glucosides are well known. One of the most poisonous representatives of the group is the active principle antiarin, from the East Indian tree so well known to legendary history as 'the deadly upas.' Its juice has been used in times of war by savage tribes to envenom their arrows. It takes but one to two milligrams of this glucoside to kill a moderate-sized dog in nine minutes. Frogs are killed with a hundredth of a milligram in twenty-four hours. The results of a most interesting investigation on the poisonous constituent of a leguminous plant of Egypt, known botanically as *Lotus arabicus*, have been recently published by two English investigators, Messrs. Dunstan and Henry. Its seeds when ripe are commonly used as fodder, but the growing plant is quite poisonous to horses, sheep and goats. It was noted that when the dry leaves were crushed and moistened with water they gave off an odor of hydrocyanic acid. An investigation revealed the presence of a glucoside, lotusin, which was hitherto unknown. Under the influence of an enzyme, also present in the plant, the lotusin was transformed into prussic acid, sugar and a new coloring matter called lotoflavine. It will thus be seen that this glucoside is very similar in its properties to amygdalin and also to linamarin from common flax. These glucosides may cause poisoning when taken into the stomach but are innocuous when administered hypodermically, for in the latter case they are excreted unchanged, while in the former they are apt to be decomposed by the acids and enzymes of the stomach.

The class of amaroids has not been well investigated chemically, but we know several compounds belonging to the group which are extremely toxic. Cicutoxin is the poisonous constituent of the common water hemlock, *Cicuta maculata,* a plant which probably causes more fatal cases of poisoning in the United States than any other plant. Digitoxin, one of the poisonous constituents of the foxglove, *Digitalis purpurea,* is poisonous to cats in a dose of 0.4 of a milligram per kilogram of body weight, while andromedotoxin, the poisonous constituent of many Ericaceous plants such as the common laurel, *Kalmia latifolia,* and the rhododendrons, is still more toxic, being fatal to frogs and to birds in a dose of 0.1 of a milligram per kilogram when injected subcutaneously. But, as we shall see, it is much less fatal when fed to birds. It is much more fatal to frogs than is atropine or strychnine.

The alkaloids are so well known that they do not need much discussion here. Aconitine is one of the most poisonous, being fatal to birds in the small dose of 0.07 of a milligram per kilogram when injected hypodermically.

The enzymes are not very well known, and in most cases they are not toxic. Some of them are, however, capable of causing disorders when injected under the skin. Very closely related to these are the toxalbumins which embrace the most deadly of all of the poisons, as may be recognized from the fact that they are the poisonous constituents of the venom of snakes and spiders, of many pathogenic bacteria, and of the most poisonous fungi, such as *Amanita phalloides.* We shall have more to say about these substances later.

Nearly all of the active principles which have been isolated from plants have also been studied toxicologically, and have been classified in different ways, but chiefly with regard to the character of their effect and the organ most seriously poisoned. We thus have those which cause marked anatomical changes of tissues, those that principally affect the blood and those that do not cause any marked anatomical lesions. The fatal dose, also, has in many cases been established, so that we can often tell how much of a given substance will kill a given animal in a given time. In this determination it is absolutely necessary, of course, that the animal tested be a healthy one, otherwise a fatal lesion may be produced by the poison simply on account of the previous weakening of the affected tissue by the disease. The time and dose limitations of poisoning are not essential in our accepted definition of a poison, for it considers only derangements of function. If these are produced even by commonly edible substances, such as sodium chloride or sugar, we are obliged to say that under the special conditions of the case in hand these substances are poisonous. Sugar is thus poisonous to a diabetic patient, while pure salt when fed regularly even in normal quantities would undoubtedly prove fatal if all other salts were withheld from the food for a considerable time; half teacupful doses of the saturated solution are said to be sometimes taken by the Chinese to commit suicide. This elimination of the time and dose elements makes it very difficult, sometimes, to distinguish poisonous substances from foods, but it is eminently satisfactory because it calls for subsequent explanation showing in what way and to what extent a substance is toxic. It calls more forcibly to mind, also, the danger in the continued use of drugs and of such narcotics as tobacco and hasheesh, and also to the flagrant and outrageous use of antiseptics in such foods as milk and bread which are consumed daily, sometimes in large quantities. Who can say how much material damage is done to the progress of civilization by this criminal practice? Until proven to the contrary, it ought to be taken for granted that any substance which has antiseptic or germicidal value is also capable of exerting these properties in a deleterious way in the human body, especially when the substance is ingested frequently for a long period of time. The Spanish people are said to be a race of dyspeptics because of their inordinate use of condiments; let us pray that the American people will never become degenerate on account of the use of the antiseptically preserved food which is too often sold in our markets.

There are 16,673 leaf-bearing plants included in Heller's 'Catalogue of North American Plants,' and of these there are nearly 500 which, in one way or another, have been accused of being poisonous. This does not, of course, mean that any one part or all of each of these plants would be fatal if eaten by man or by any one kind of an animal, but simply this, that some part or parts of each, at some period of the plant's growth, contain an active principle which is capable of causing death or some serious derangement of function in one or more forms of animal life when administered in a certain way, not necessarily by way of the mouth. Snake venom is none the less poisonous because it can be swallowed with impunity in considerably more than what would be a fatal dose if injected into the skin in the natural way through the serpent's fangs; neither is the death cup, *Amanita phalloides,* to be considered non-poisonous because it has been eaten after the poison was extracted by chemical methods. Other plants may be eaten with other things which will either enhance their poisonous effect, as in the case of amygdalin when an amygdalin-splitting ferment is also consumed, or counteract it, as might be the case when other medicinal plants are eaten; others again may be considered non-poisonous because the active constituent may be removed or destroyed from the plant by boiling or by drying; and finally others may be declared innocent because the poison is not present in the part consumed, or is present only at certain brief stages of growth; the amount present might also have been increased or diminished according to the conditions of growth or cultivation of the plant, as is most commonly the case in those which are cultivated for their medical value.

We cannot take time to even mention all of the unsolved problems which have arisen in connection with all of these suspected plants, but there are several interesting questions in connection with the variable amount of poison present in a plant, its variable location in the plant, and especially the variable effect upon animals, that should receive special attention.

Few poisonous plants are of sufficient commercial importance to have been investigated chemically with anything like the detail necessary in order for one to draw definite conclusions in regard to the development of their poisons, or of their location in the plant, but all druggists and physicians are aware that the chemical compound by virtue of which a drug is of therapeutic value is almost invariably more abundant in one part of a plant than in another. The same is true of all plant compounds. The variability of cultivated drugs in their contents of active principles was alluded to above. A more satisfactory example of how artificial environment can affect the chemical constituents of plants may be found in a Bulletin recently published by Dr. H. W. Wiley, Chief of the Bureau of Chemistry of the Department of Agriculture, and entitled 'The Influence of Environment upon the Composition of the Sugar Beet.' In this bulletin it is shown that the factors which determine the maximum yield of sugar are as follows: high latitude, free use of fertilizers, and an even distribution of a rainfall of from three to four inches during the months of May, June, July and August, and a reduction of rainfall for September and October.

Natural environment affects some poisonous plants in a similar way, but in this case the more southerly plants are apt to have a greater development of the active constituents than those further north. This is particularly noticeable in the Indian hemp, *Cannabis sativa.* The plants of the Southwest contain a larger quantity of the active principles than the more northerly ones do. A striking example of the possible diurnal variation of the amount of poison in the leaves of plants is shown in a very instructive investigation by Dr. J. P. Lotsy of the cinchona plant. The author showed that the quantity of alkaloids varied greatly in the leaf as taken by day or night and on sunshiny or cloudy days, being most abundant in the first instance in each case. He showed also that these alkaloids are formed in the leaves during the day and are almost wholly deposited in the branches or bark at night. If gathered in the early morning therefore cinchona leaves would be practically inert, while if gathered in the evening, especially on a sunshiny day, they would be in their most active condition. The foliage is, in general, the part of a plant which causes most cases of stock-poisoning. The period of leaf maturity is regarded by some cultivators of medical plants as being the time at which its chlorophyll content is most highly developed, or when the leaves are most intensely green. This is generally soon after the flowering time in the case of herbaceous plants, but with some, such as the aconite, the purple larkspur and the poison camas of Montana, and many bulbiferous plants closely related to the last, it is earlier, the leaves of some of these having commonly dried up before the plants have flowered. In such cases the leaves would naturally be most active physiologically if eaten before the plants blossom, and might be practically inert at other times. Such is probably the case with the purple larkspur and death camas just referred to. The active principles are sometimes found most abundant in the most rapidly growing parts of the plant, as in the white sprouts of potatoes, and again they are to be found in parts which have been fully developed, as in the case of sapotoxin in the corn cockle, *Agrostemma githago.* It has recently been shown that in aconite seeds the central parts contain most of the aconite, while the seed coats are free from it. In the calabar bean the very poisonous alkaloid eserine is found in the cotyledons. In the seeds of the common jimson weed and black henbane the alkaloids are located chiefly in the layer beneath the epidermis; the epidermis itself and the seed covering of each are free from alkaloids. In jimson weed the quantity of alkaloids in un-sprouted seeds was found to be fifteen times as great as in sprouted seeds, and in the seedlings of the jequirity bean, *Abrus precatorius,* it has been definitely shown that most of the toxalbumin is retained in the cotyledons. In growing colchicum the percentage of alkaloid is high in the growing tips and comparatively low in the lower part of the bulb. The first year's crop of leaves of foxglove and of henbane is inferior to that of the second on account of the smaller quantity of active principle. The variation in strength of the powerfully poisonous drug known as strophanthin is so well known to physicians that its medical use is being abandoned. Many such instances might be cited, but these show the importance of knowing the entire history of a plant in testing its character as poisonous or non-poisonous.

There are several molds and smuts which often infest corn and fodder. We know that some of these, when eaten or inhaled, sometimes cause death in a mechanical way by clogging up the system by their growth within the body, but there is much reason to believe that some of them contain poisons which are either consumed with the mold or are generated *pari passu* with the growth of the mold in the body. Probably some of these compounds like the sulphocyanic acid of *Aspergillus niger*—a weak poison—are absorbed with difficulty, especially when taken into the stomach, and this may be the reason why the plants are often eaten with comparative impunity. But are there not conditions when a greater quantity of toxic substances may be present in them, or may there not be a condition of the system in which the poison is more easily absorbed? The large number of cases of stock-poisoning said to have been caused by molds and smuts demand an extended investigation.

Another problem which is essentially of the same nature is in connection with the large polymeric group of saponin-like glucosides. These substances are, as a rule, not very poisonous when taken into the stomach, but it is a noticeable fact that few of the many plants which contain them are eaten by animals. Some are, however, eaten both by the lower animals and by man, as is the case with the fruit of the Moreton Bay chestnut or bean tree, *Castanospermum australe,* of Australia. Some persons assert that this fruit is edible, others that it is merely indigestible, while still others are emphatic in regard to their deleterious effect upon man. Nearly all of the saponins are difficult to dialyze, so it is quite probable that when taken into the stomach they are ordinarily excreted before they can accumulate in sufficient quantity in the blood to cause symptoms of poisoning, but in other cases where poisoning has resulted it seems probable that some condition of the digestive tract, perhaps ulceration, has facilitated the absorption of the compound into the system, where it at once exerts the same powerful effect that it does when injected hypodermically.

Some animals are, for various reasons, entirely immune against the effect of certain poisons. This difference in susceptibility is, in general, correlated to the mental development of the animals compared. The brain and nerve poisons, such as morphine and atropine, are much less poisonous to animals than man. Dogs and horses can, in proportion to their weight, endure ten times as much morphine as man, while doves can stand 500 times and frogs even a thousand times as much. In herbivorous animals, especially in those which chew their cud, such as sheep and cattle, the digestive tract is much longer than in the case of omnivorous or carnivorous animals, consequently the food remains in the body for a much longer period. In case of herbivorous animals this period is usually several days, while in carnivorous animals it is about twenty-four hours only. In the former case, therefore, the poison would have much more time to become absorbed into the blood than in the latter. This, according to Fröhner, probably explains why it is that the metallic poisons are much more fatal to herbivorous than to carnivorous animals.

The flesh of an immune animal to which a large dose of poison has been administered is apt to be poisonous to other animals that eat it if they themselves are not immune to its effects. For example, it is asserted that advantage is taken of this fact in our Southern States in feeding strychnine to chickens in order to poison the hawks that prey upon them. Cases of human poisoning may inadvertently occur by thus eating the poisonous principles of plants which are present in the honey, the milk or the meat derived from certain plants.

All grades of merit or flavor are attributed to the honey derived from plants, thus indicating that the chemical constituents which give characteristic odors and tastes to flowers are often transferred directly to the honey derived from them. Some of the undesirable constituents of nectar are probably eliminated by the bee in some little-known way, and other portions are perhaps selectively retained. Formic acid is a poisonous substance which is found as an apparently essential constituent in all honey, but as it is present only to the extent of about three grains per liter it does not produce toxic effects. Gelsemine, the poisonous constituent of the southern jessamine, *Gelsemium sempervirens,* is said to have been found in honey from Branchville, South Carolina, and andromedotoxin has lately been found in honey from *Rhododendron ponticum* of Europe. The most convincing proof that poisonous honey may be derived from rhododendrons and that its toxicity may be due to andromedotoxin has been furnished by Plugge and Thresh. The former has obtained the poison from the nectar of *Rhododendron ponticum;* the latter found it in 1887 in a sample of honey from Trebizond.

Cases of poisoning from milk are more apt to happen nowadays from the use of preservatives and from bacterial toxines rather than from any other causes, but cases arise from milk becoming sour while in metallic containers or from the plants eaten by an animal. The effect of garlic on milk is well known but it is not so well known that cabbage and turnips also give milk a bad taste. Chicory imparts a bitter flavor to milk and Dyer's weed, *Genista tinctoria,* is said to make the butter and even the cheese made from milk derived from it very unpleasant to the taste. Kobert states that children have been killed by the milk of goats that had eaten colchicum or the broom plant. In my 'Preliminary Catalogue of Plants Poisonous to Stock' mention was made of a severe case of poisoning which was due to drinking milk from a cow that had been feeding on mandrake, and investigations made by Dr. E. V. Wilcox and myself in Montana show that lambs are frequently killed by sucking milk from their mothers after these had eaten death camas, *Zygadenus venenosus.* It was a common impression throughout various districts in the South only a few years ago that the disease known as 'milksick' was due to milk from cows that had been eating poisonous plants. This problem has never been solved, although the disease is still reported occasionally. Other cases of such poisoning are comparatively rare, but two have recently been reported to the Department of Agriculture, one from Nebraska and another more important one from the Pecos Valley in New Mexico. The butter and cheese were also suspected in the latter case.

The interest in connection with poisonous honey is both theoretical and practical; that with poisonous game is, perhaps, only theoretical, since no cases have been called to public attention for many years and the records of past cases are few in number. To determine whether the flesh of a bird or animal that has eaten a poisonous plant is poisonous or not it is necessary to prove: first, that the birds or animals in question may eat the suspected plants with impunity to such an extent as to render their flesh poisonous; and secondly, that, perhaps under stress, they actually do so. This latter point can be solved only by the close study of actual cases. An attempt was made by the writer a few years ago to examine into the former question, especially in connection with some historic cases of poisoning, supposed to have been due to eating partridges which had fed on mountain laurel, *Kalmia latifolia*. It is true that partridges eat laurel leaves in winter, and that they may not be poisoned thereby. I have seen as much as 14 grams of the leaves taken from the crop of a single partridge, yet this bird was eaten without any ill effect arising therefrom. In this case, however, the leaves were still in large pieces many of them being over a half inch square. The andromedotoxin was, therefore, not extracted, and, unless the bird's previous meal consisted of the same food, its flesh could not have contained much of the poison. Andromedotoxin was fed for several days in gradually increasing doses to a chicken, which, at the end of the fourth day, had received a very large dose without affecting it at all seriously. The chicken was then killed, cleared of entrails, boiled for a half hour and fed to a cat with the result that it was very badly, but not fatally, poisoned. Similar problems might be suggested in connection with the poisonous plants eaten by game animals, and especially in connection with the edibility of fish caught for food by the use of plants thrown into the water to stupefy and poison them. Some detective work, also, is desirable to determine to what extent poisonous plants are clandestinely added to whiskey and other alcoholic beverages to increase their intoxicating effect. It is reported that in some country districts throughout the South use is thus made of the leaves of mountain laurel and other andromedotoxin-containing plants.

The practices above mentioned suggest another subdivision of my paper, and that is the effects of the habitual use of narcotic plants. In the United States this use is confined mainly to tobacco smokers, but it is interesting to note that the use of Indian hemp is spreading throughout the Southwest, where it was most probably introduced from Mexico. The effect of this drug is well known from accounts published in the daily press and elsewhere. The common Mexican name of the plant in '*mariguana*,' but this name is also applied in some parts of Mexico to a native *Datura, D. meteloides,* much like our common jimson weed. Both of these plants and others, such as the tree tobacco, *Nicotina glauca,* are sometimes called locoweeds in Mexico. 'Loco' is a Spanish word which, in its original sense, means mad or crazy. Of late, however, it has been extensively applied, especially in northern Mexico and the United States, to certain plants which so affect the brain of animals that eat them as to cause chronic derangements of the power of thinking and of coordinating movement. It is, however, most popularly applied to several weeds—*Astragalus* and *Aragallus* spp.—of the bean family, which cause a peculiar kind of insanity in animals that eat them. It is not uncommonly asserted by Mexicans that sometimes a single dose of hemp will cause long-lasting insanity. Van Hasselt, a Dutch authority on poisonous plants, also asserts that a single dose of this drug may cause mania for months, but the best pharmacologists are agreed that such might be the case only when the person affected is already badly diseased by the use of drugs or otherwise. There is reason for scepticism here, especially in regard to the crazing effect of single doses, but it is highly desirable that the subject be inquired into to find out how little of any one plant can cause insanity in a short time. With the true locoweeds of our Western prairies I am satisfied that at least several days' feeding is necessary to produce any bad effect. The Department of Agriculture is at present engaged in an investigation of the curious behavior of these weeds.

The question of disease-producing food presents many important problems closely related to those mentioned above. Aside from the study of locoism there are such problems as the relation of ergotism to the ergot of rye; of lathyrism to the seeds of the species of *Lathyrus* and *Vicia,* both commonly represented in our native flora; of the so-called 'bottom disease' of Missouri and the seeds of the rattlebox; of githagism to the seeds of the common corn cockle which is abundant in the wheat fields of the middle Northwest, and also to the spring cockle, *Vaccaria vaccaria,* which is also becoming common in the extreme Northwest, and finally the relation of dry food or of dry moldy foodstuffs to blind staggers or cerebro-spinal meningitis and the so-called cornstalk disease of the middle Western States.

The toxic theory of disease is by no means a new theory, for Albrecht von Haller advanced it about the middle of the eighteenth century in connection with the extracts of putrefying animals, but it has received proper prominence only lately in connection with the toxalbumins, the first of which to be described was 'echidnin' or 'viperin.' This was extracted in 1843 by by Prince Louis L. Bonaparte, from the venom of vipers. Crotalin, the poison of the rattlesnake, was described by Dr. S. Weir Mitchell, an American, in 1860. But it was not until after 1884, when two English chemists, Warden and Wadell, isolated abrin from the seeds of jequirity, *Abrus precatorius,* that these bodies were closely investigated in plants. Since 1884 ricin has been isolated from the castor-oil bean, crotin from a bean of the same family, phallin from the deathcup fungus, *Amanita phalloides;* and robin from the bark of the common locust. From many pathogenic bacteria and from some poisonous spiders similar compounds have been isolated. All resemble ordinary albumen in being coagulable by heat and all are remarkably poisonous, but death often ensues only after several days when the poison has been taken internally. After these substances once get into the blood there is no established method of offsetting their effects. There is, however, a most interesting method of preventing and perhaps offsetting their effect which is bound to come more and more into general use. I refer to the use of blood serum and to the various artificial ways of producing immunity or a high degree of tolerance.

Ehrlich, a German investigator, first showed in 1891 that animals can be made to endure very large doses of two plant toxalbumins, abrin and ricin, and, in 1897, Cornevin showed that by heating ricin to a temperature of 100° C. for two hours a substance is formed which, when injected two or three times under the skin of hogs, ruminants or chickens, will produce immunity against the effects of ricin for several months. The essential factor of success in combating these poisons within the body seems to be the development of an increased number of white blood corpuscles within the body. It has been experimentally proven that these corpuscles are not only capable of attacking the destroying bacteria, but also of destroying toxic substances present in the body, the chemical reaction involved being probably an oxidation. These bodies contain an oxydase or oxidizing ferment, and it is known that such oxidizing bodies as permanganate of potash and chloride of lime easily oxidize most if not all of the toxalbumins and thus render them harmless. Any substance, therefore, which is capable of developing a larger number of white corpuscles in the body would serve as a kind of antitoxine against these poisons and it would not appear to be necessary that each particular toxine should have a separate antitoxine. Indeed, experiments show that antitoxines are not chemical antagonists to toxines, but act simply as stimulants to the body to manufacture its own antidote. Certain chemicals, such as sodium hypochlorite and nuclein, an albuminoid obtained from cæsine or from beer yeast, stimulate the production of these cells, and these substances may, therefore, be looked upon as antitoxines. Whether or not these substances will also stimulate the white corpuscles or the other oxidizing organs of the body so that they will offset the effect of plant poisons is a problem which is yet to be solved. It is not known how many poisons the leucocytes are able to destroy in the body, but if their action is really in the nature of an oxidation we may assume that all poisons which are harmless when oxidized, as plant poisons are apt to be, would be destroyed by them whenever they gained access to the blood, providing, of course, that the leucocytes were in sufficient abundance to do the work. We see then the great importance both from the poisonous-plant point of view and for general prophylactic effect against disease of building up an animal's system so that it will contain a maximum quantity of leucocytes. It is probably impossible to stimulate the formation of leucocytes so rapidly that the process would be available for immediate treatment in cases of acute poisoning, but, since it requires only four or five days to produce immunity to snake venom by repeated injections of a dilute solution of the chloride of lime, it might possibly be useful in chronic cases where the poison concerned is harmless when oxidized.

A particularly interesting phase of oxidation in relation to germicidal action has recently been investigated by Professors Freer and Novy at the University of Michigan. Their preliminary paper shows an interesting comparison of the germicidal effect of:

Hydrogen peroxide...... $H—O—O—H$.
Benzoyl peroxide....... $C_6H_5CO—O—O—COC_6H_5$.
Acetyl peroxide........ $CH_3CO—O—O—COCH_3$.
Benzoyl acetyl peroxide. $C_6H_5CO—O—O—COCH_3$

It will be noticed that the three organic compounds are symmetrical like that of hydrogen peroxide. The amount of available oxygen in each compound is the same but the germicidal action of each varies greatly. The use of hydrogen peroxide as a germicidal agent, especially in strong solution, is well known. Benzoyl peroxide is almost insoluble in water and is not hydrolyzed; it is therefore of no value as a germicide. The last two compounds have no germicidal value of themselves, but they are readily hydrolyzed in the presence of water yielding benzo peracid $C_6H_5CO—O—OH$, and aceto peracid $CH_3CO—O—OH$, both of which have a very marked germicidal value. These organic peracids or peroxides are, according to the authors, at least several hundred times more active than is hydrogen peroxide. The active oxygen content is the same in each, so that the difference in effect cannot be due to nascent oxygen. Hydrogen peroxide loses its available oxygen readily and even violently on contact with enzymes, but these organic peroxides do not. The authors were, therefore, forced to the conclusion that the difference in action is due to the behavior of the acid ions. In this case, therefore, it is the benzoyl and the acetyl ions and not the oxygen which does the germicidal work.

In close connection with this investigation there is another recent piece of work suggestive of important problems in connection with the chemistry and physiology of plant poisons which I wish to allude to before closing, and that is the paper by Dr. A. P. Mathews entitled 'The Nature of the Nerve Impulse,' published in the March *Century*. This treats of nerve stimulation and nerve paralysis on the basis of our modern theories on the nature of solution, a trend of investigation now being carried on at the Hull Physiological Laboratory of the University of Chicago under the direction of Dr. Jacques Loeb, Professor of Physiology at the institution. The author's conclusions are as follows:

"It has been shown: first, that the chemical stimulation of protoplasm is really an electrical stimulation; second, that the poisonous action of inorganic salts is due to the electrical charges of the salts and probably to the movements of these charges: third, that the negative charges stimulate protoplasm, while the positive prevent stimulation, and if not counteracted by the negative will destroy life; fourth, that muscle contraction is probably in its essence an electrical phenomenon and that the conduction of a nerve impulse is almost certainly an electrical phenomenon; fifth, for the first time we have a physical explanation which agrees with all the main known facts of the nerve impulse and changes in irritability; sixth, we have secured a physical explanation of the way in which an anesthetic produces its effect; seventh, we are led to the hypothesis of the identity of stimulation by light and by chemicals."

The author does not, in this paper, discuss the possible effect of the ions of plant poisons, but it is difficult to see if his theory really holds good for organic compounds, why the complex cathion of so many alkaloids should be so extremely poisonous, and one is forced to wonder how any acid ion could be found which could be powerful enough to offset the toxic effect. One is also tempted to wonder if death can be the complete physiological opposite of life, for is there not a tremendous difference between the automatically reversible character of the cell protoplasm which enables it alternately and in rapid succession to solidify and redissolve, and the simple irreversible solid or liquid state which is the result of death?

In the foregoing paper I have attempted briefly to discuss some of the practical, as well as some of the theoretical, features of plant poisons, throwing out suggestive hints rather than concrete problems here and there, and although I feel that the ground has not been adequately covered, I trust that at least some of you have been interested in the discussion, and I venture to express the hope that some of the suggestions have fallen on good ground and will result some day in a rich harvest of facts giving solutions to some of the problems suggested.

V. K. Chesnut.

United States Department of Agriculture,
Washington, D. C.

SCIENTIFIC BOOKS.

Reports on Plans for the Extermination of Mosquitoes on the North Shore of Long Island, between Hempstead Harbor and Cold Spring Harbor. Published by the North Shore Improvement Association. 1902. Pp. 125.

This is an extremely interesting and in some ways a most remarkable publication. It is a sign of the times that a number of men interested in a given territory should form themselves into an improvement association whose principal aim seems to be to do away with the mosquito pest, though that is not especially mentioned in the published list of objects. It is remarkable that, besides expending many thousands of dollars to attain that end, they should also publish their results at an expenditure of hundreds more, for the benefit of others contemplating similar improvements.

'Reports' contained in the volume are made by the Executive Committee; by their engineer, Mr. Henry Clay Weeks; by Professor N. S. Shaler, of Harvard University; by Professor Charles B. Davenport, of the University of Chicago, and by Mr. Frank B. Lutz, of the same place.

Professor Shaler deals chiefly with the matter of salt marshes, their value when reclaimed, the methods of reclamation and the crops that may be planted on such areas. The paper is an interesting one, general in its scope, without pretense to novelty, but informing in character.

Professor Davenport and Mr. Lutz, each with an assistant, report on the entomological work done, which consisted mainly of a thorough survey of the territory covered by the association, and the determination of the breeding places for mosquitoes of all kinds. *Culex* and *Anopheles* are nearly always lumped and specific terms rarely appear. There is nothing, therefore, to determine what species actually occur and what species are actually troublesome. The usual generalized life histories are given and the usual recommendations applied to the specific conditions are made. No original investigations seem to have been carried on and no novelty is claimed; the report is informing in its general character, and is a model of thoroughness within its scope. It is to be regretted that, especially in *Culex,* the species found breeding in the various localities are not determined. It is by no means certain that for practical purposes all mosquitoes should come under an equal ban, and nothing in the report shows whether the mosquitoes so often referred to were such as were breeding in the waters near by, where larvæ were found.

The report of the engineer is supplemented by an elaborate map on a scale sufficient to admit of the marking of all points where treatment is necessary or where engineering work is required. It is confined to the local problem and no generalizations are attempted.

Altogether the 'Reports' show a well-organized effort, intelligently carried out, which is bound to secure the desired results in due time. It may be a question whether the results could not have been obtained by a somewhat less elaborate and expensive organization; and it may be that the staff employed by its very excellence and the expense incurred may deter rather than encourage smaller or less wealthy bodies from embarking in similar works.

To secure general cooperation in the campaign against mosquitoes the methods must be of the simplest and cheapest that will prove effective. But on this latter point the 'Reports' deserve unqualified praise for the stand taken, that destruction of breeding places, not the never-ending destruction of larvæ, should be aimed at; that permanent works rather than merely palliative measures should be the aim of the asssociation.

JOHN B. SMITH.

NEW BRUNSWICK, N. J.,
June 12, 1902.

Researches on Cellulose, 1895–1900. By CROSS & BEVAN. London, New York and Bombay, Longmans, Green and Co. 1901. 8vo. Pp. 180.

The first work on cellulose by these authors, published in 1895, was an attempt to bring together into convenient shape, and, as far as possible, into logical arrangement, the scattered and largely unclassified knowledge on this important subject. That they made an excellent beginning in bringing order out of chaos few investigators familiar with the subject will deny. The first work has been and is of decided value both to the scientific and the industrial worker. The present volume reviews the researches on cellulose from 1895 to 1900. The matter is arranged under the following sections: Introduction, dealing with the subject in general outline; Section I., 'General Chemistry of the Typical Cotton Cellulose'; Section II., 'Synthetical Derivatives—Sulphocarbonates and Esters'; Section III., 'Decompositions of Cellulose such as throw Light on the Problem of its Constitution'; Section IV., 'Cellulose Groups, including Hemicelluloses and Tissue Constituents of Fungi'; Section V., 'Furfuroids, *i. e.*, Pentosanes and Furfural-yielding Constituents Generally'; Section VI., 'The Lignocelluloses'; Section VII., 'Pectic Group'; Section VIII., 'Industrial and Technical; General Review'; Index of authors; Index of subjects.

The authors should be highly commended for their appreciation and treatment of the practical industrial problems connected with cellulose. Pure science is not lowered in the estimation of most men because it may have practical bearings, and it is almost needless to say that some of the greatest advancements in scientific knowledge have been brought about by men who had an eye for the practical as well as the scientific side of investigations. The subject is developing rapidly at the present time from both the scientific and the practical side, and it certainly offers an inviting field for students of chemistry who wish to make their work count for something in the commercial as well as the scientific world.

A. F. Woods.

SCIENTIFIC JOURNALS AND ARTICLES.

The *Journal of Comparative Neurology* for June contains the following articles: (1) 'Number and Size of the Spinal Ganglion Cells and Dorsal Root Fibers in the White Rat at Different Ages,' by S. Hatai. The number of spinal ganglion cells does not change with age, though some small cells become large cells and the number of dorsal root fibers increases. (2) 'Observations on the Medulla Spinalis of the Elephant with some Comparative Studies of the Intumescentia Cervicalis and the Neurones of the Columna Anterior,' by I. Hardesty. In addition to the histological examination of the elephant, there is a similar study of the spinal cords of a series of twelve mammals of diminishing body weights, with statistics of the ratios to body weights of the dimensions of the spinal cord and ventral horn cells. (3) 'Observations on the Post-mortem Absorption of Water by the Spinal Cord of the Frog,' by H. H. Donaldson and Daniel M. Schoemaker. There is a post-morten absorption of water by the spinal cord of *Rana virescens* amounting sometimes in 24 hours to 25 per cent. of the normal weight of the cord. The conditions under which this absorption takes place were experimentally studied. (4) 'Observations on the Developing Neurones of the Cerebral Cortex of Fœtal Cats,' by S. Hatai. Confirms Paton's observation that the dendrites develop before the neurites or axones. The usual literary notices complete the number.

The contents of the *American Journal of Mathematics* for July, 1902, are as follows:

'Die Typen der linearen Complexe elliptischer Curven im R_r,' von S. Kantor; 'Generalization of the Differentiation Process,' by Robert E. Moritz; 'Simple Pairs of Parallel *W*-Surfaces,' by Henry Dallas Thompson.

SOCIETIES AND ACADEMIES.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

We have received preliminary lists of the papers to be presented before three sections of the Pittsburg meeting of the American Association for the Advancement of Science, as follows:

SECTION C AND THE AMERICAN CHEMICAL SOCIETY.

Tuesday, July 1, 1902.

'Valence': Ira Remsen.

'The Ozone from Potassium Chlorate': Edward Hart.

'Electric Combustion': Edward Hart.

'The Chlorides of Ruthenium': Jas. Lewis Howe.

'Electrolytic Deoxidation of Potassium Chlorate': Wilder D. Bancroft.

'The Solid Phases in Certain Alloys': Wilder D. Bancroft.

'An Improved Grinder for Analysis of Motherbeets': David L. Davoll, Jr.

'The Electrical Conductivity and Freezing Points of Aqueous Solutions of Certain Metallic Salts of Tartaric, Malic and Succinic Acids': O. F. Tower.

'Recent Progress in the Fireproofing Treatment of Wood': Saml. P. Sadtler.

'Ionic Velocities in Liquid Ammonia Solutions': E. C. Franklin.

'The Expansion of a Gas into a Vacuum and the Kinetic Theory of Gases': PETER FIREMAN.

'Quantitative Blowpipe Analysis by Bead Colorations': JOSEPH W. RICHARDS.

'Solubility, Electrolytic Conductivity, and Chemical Action in Liquid Hydrocyanic Acid': LOUIS KAHLENBERG and HERMAN SCHLUNDT.

'Determination of Glucose': EDWARD GUDEMAN.

'Gluten Feed Analyses': EDWARD GUDEMAN.

'Arsenic Pentachloride': CHARLES BASKERVILLE and H. H. BENNETT.

'Black Rain in North Carolina': CHARLES BASKERVILLE and H. R. WELLER.

'A New Method for the Preparation of Pure Praseodymium Compounds': CHARLES BASKERVILLE and J. W. TURRENTINE.

'Deportment of Pure Thorium and Allied Elements with Organic Bases': CHARLES BASKERVILLE and F. H. LEMLY.

'A New Constant High Temperature Bath': CHARLES BASKERVILLE.

'A Process for Rendering Phosphoric Acid Available': CHARLES BASKERVILLE.

'Molecular Attraction': J. E. MILLS. (By title.)

'Condensation of Chloral with the Nitranilines': A. S. WHEELER and H. R. WELLER.

'The Composition of Urine and its Relation to Electrical Conductivity': JOHN H. LONG. (By title.)

'Symmetrical Trimethylbenzyl, Symmetrical Trimethylbenzol Hydrazone and some of its Derivatives': EVERHART P. HARDING.

'1. 4. Dimethylbenzyl, 1. 4. Dimethylbenzol Hydrazone and some Derivatives': EVERHART P. HARDING.

'The Action of Valerianic Acid and Valeric Aldehyde upon Antipyrin': DAVID C. ECCLES.

'On Conductivity': GEORGE A. HULETT.

'Relation between Negative Pressure and Osmotic Pressure': GEORGE A. HULETT. (By title.)

'Comparison of Results Obtained by Different Methods of Determining the Amount of Oxygen Absorbed by Waters Containing Oxidizable Substances': LEONARD P. KINNICUTT.

'The Old and the New in Steel Manufacture': WM. METCALF.

'Some Notes on Glass and Glass Making': ROBERT LINTON.

'Manufacture of Optical Glass': GEORGE A. MACBETH.

'Bessemer and Open-Hearth Steel Practice': EDWARD H. MARTIN and WM. BOSTWICK.

'Malleable Iron': H. E. DILLER.

'Manufacture of Plate Glass': FRANCIS P. MASON.

'Manufacture of White Lead': GERARD O. SMITH.

'Camphoric Acid: Synthesis of Trimethylparaconic Acid': W. A. NOYES and A. M. PATTERSON.

'The Hydrolysis of Maltose and Dextrine for the Determination of Starch': W. A. NOYES, GILBERT CRAWFORD, C. H. JUMPER, E. L. FLORY.

'Crucible Steel Manufacture': E. L. FRENCH.

SECTION D, MECHANICAL SCIENCE AND ENGINEERING.

'The Trend of Progress in Prime Movers': Director R. H. THURSTON, Cornell University.

'On Changes in Form as an Essential Consideration in the Theory of Elasticity': Mr. FRANK H. CILLEY, Brooklyn.

'On the Advantage of Siamesed Hose Lines for Fire Steamers': Professor MANSFIELD MERRIMAN, Lehigh University.

'The Nomenclature of Mechanics': Professor R. S. WOODWARD, Columbia University.

'U. S. Work in the Ohio, Allegheny and Monongahela Rivers near Pittsburg': Mr. THOMAS P. ROBERTS, Pittsburg.

'On a Type of Planetary Orrery Using the Mechanical Principle of the Conical Pendulum': Professor DAVID P. TODD, Amherst College.

'On the Ratio of the Transverse to the Longitudinal Elastic Strain Produced by Longitudinal Stress': Professor THOMAS GRAY, Rose Polytechnic Institute, Terre Haute, Ind.

'On the Effect of Hardening Steel on its Young's Modulus': Professor GRAY.

'A Test of a Ball Thrust Bearing': Professor GRAY.

'A New Photometer, with Exhibition of the Instrument': Professor C. P. MATTHEWS, Purdue University.

'The Mechanics of Reinforced Concrete Beams': Professor W. K. HATT, Purdue University.

'Some Experiences with a Simple Babbitt Testing Machine': Mr. E. S. FARWELL, New York City.

'The Rules and Regulations Concerning Airship Contests at the Louisiana Purchase Fair': Professor C. M. WOODWARD, Washington University, St. Louis.

'Long Distance Electric Transmission Regarded as a Hydrodynamic Phenomenon': Professor H. T. EDDY, University of Minnesota.

'The Effect of Weeds and Moss upon the Coefficients of Discharge in Small Irrigating Canals': Professor J. C. Nagle, College Station, Texas.

It is expected that an evening illustrated stereopticon lecture will be given before this section by Captain Sibert upon the bridges and other interesting structures of the Philippines.

The first excursion of the Section will probably be on Tuesday afternoon, July 1, to the famous Carnegie Homestead plant. Other excursions to similar points are arranged and will be available to the members of the Section to any extent desired.

SECTION H, ANTHROPOLOGY.

Monday, June 30, 1902.

'Address of Retiring Vice-President': J. Walter Fewkes.

'The Human Effigy Pipe, taken from Adena Mound, Ross Co., Ohio': Wm. C. Mills.

'Burials of Adena Mound': Wm. C. Mills.

'Gravel Kame Burials in Ohio': W. K. Moorehead.

'Microscopical Sections of Flint from Flint Ridge, Licking Co., Ohio': Wm. C. Mills.

'Explorations of 1901 in Arizona': Walter Hough.

'The Throwing Stick': George H. Pepper.

'A Collection of Crania from Gazelle Peninsula, New Britain': George G. MacCurdy.

'Climatic Changes in Central Asia traced to their Probable Causes and Discussed with Reference to their Bearing upon the Early Migrations of Mankind': G. Frederick Wright.

'Dr. Thomas Wilson's Career at Washington': W. K. Moorehead.

'Anthropological Museums in Central Asia': G. Frederick Wright.

'Anthropological Museums and Museum Economy': Stewart Culin.

'Classification and Arrangement of the Collections of an Anthropological Museum': W. H. Holmes.

'Methods of Collecting Anthropological Material': Harlan I. Smith.

'Preservation of Museum Specimens': Walter Hough.

July 2 and 3, meeting with the American Folk-Lore Society.

BIOLOGICAL SOCIETY OF WASHINGTON.

The 357th meeting, the last of the season, was held on Saturday evening, May 31.

D. E. Salmon and C. W. Stiles presented a communication, made by Dr. Stiles, on 'Surra, a Disease in the Philippines of Great Military Importance.' The speaker stated that the disease known as surra has been diagnosed among the horses in the Philippines, and has led to the prohibition of landing any animals from those islands at any ports of the United States or of the dependencies thereof.

This disease is caused by a microscopic parasite (*Trypanosoma Evansi*) which lives in the blood, and the evidence now accessible indicates that this organism is transmitted by means of biting flies, especially by members of the genus *Tabanus* (horse-flies); other methods of dissemination are not excluded. It is chiefly a wet-weather disease, and is reported as invariably fatal to horses and mules. It occurs in other animals—such as camels, elephants, dogs, cats, etc.—more rarely in ruminants, and may be transmitted to goats, sheep and other mammals, but is not yet reported for birds. It is more or less common in India. Its introduction into the Philippines is unexplained, but it has probably existed there for some years past.

Parasites closely allied to this species occur in Europe, Africa and South America, in some cases causing disease known as tsetse-fly disease, dourine, mal de caderas, and rat trypanosomiasis. Certain authors believe that some of these maladies are identical with surra.

The chief symptoms of surra are fever, of an intermittent, and sometimes relapsing type; urticarial eruption; petechiæ on the mucous membranes; progressive anemia and emaciation; ravenous appetite and extreme thirst; more or less paralysis.

Treatment has not been satisfactory, but arsenic has been followed by good results in some cases. Prevention is difficult, but should consist in protecting horses from flies. Immediate isolation of the sick animals and protecting them from flies will result in restricting the disease. In some cases it will perhaps be better to kill and immediately destroy the diseased animals.

From both the military and economic points of view surra must be looked upon as a very serious matter, and its introduction into the United States would result in very heavy losses.

Barton W. Evermann spoke on 'The American Species of Shad,' stating that from time to time reports had been received by the U. S. Fish Commission of the capture of shad in the Mississippi basin, but that these reports had proved either to have no foundation or to be based on some other fish. In 1897, however, Mr. James Sowders, of Louisville, forwarded four specimens of a true shad, saying that he had taken a few each year for many years past, but that only recently had he captured them in any number. The specimens proved to be a new species, which has been named *Alosa ohiensis;* it is more slender than the Atlantic shad, and has fewer gill rakers while it is much more slender than the Alabama shad and has more gill rakers than that species.

F. A. LUCAS.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of June 2—sixteen persons present—Professor A. S. Langsdorf described the factory tests that are made on electrical machinery, illustrating the subject by lantern diagrams showing the circuits employed for the various tests, and by pictures of the machines as set up for testing in the factory.

A biographical sketch of the late Dr. A. Litton, one of the first members of the Academy, by Dr. G. C. Broadhead, was presented by Dr. Hambach.

Mr. H. A. Wheeler spoke of the occurrence, at Hematite, Mo., some forty miles below St. Louis, of a number of granite boulders, some of them showing the polishing action of ice; and accounted for their occurrence at this point, or some fifty miles beyond the southern limit of the terminal moraine, by the theory that they had been carried there on cakes of ice during the Loess period.

Mr. Wheeler and Professor Nipher discussed a recent newspaper account of the alleged finding of a meteorite that was recently seen to fall in St. Louis, and agreed that the supposed meteorite, which both of them had examined, was merely a pyrite concretion from the coal measures, of the type called 'sulphur-balls' or 'nigger-heads,' which had probably been raked out from the grate-bars of the adjoining factory, and passed off on its discoverer as a meteorite.

Four persons were elected to active membership.

WILLIAM TRELEASE,
Recording Secretary.

DISCUSSION AND CORRESPONDENCE.

THE EXPLOSIVE FORCE OF VOLCANOES.

TO THE EDITOR OF SCIENCE: Mr. A. E. Verrill's hypothesis as to the explosive forces of volcanoes, published in your columns, May 23, 1902, was most interesting.

His theory as to the disassociation of the hydrogen and oxygen of the water penetrating by submarine channels to the base of the volcanoes accounts for many of the phenomena. The separation is not immediate, but the water is probably first converted into steam; this is then superheated and the oxgyen is burned out and the hydrogen liberated expands with terrific force and its further heating gives it increased power. This would account for the groanings and rumblings in the mountain itself before the outbreak. When the mass of overlying matter is no longer heavy enough to resist the immense internal pressure, it gives way and a violent explosion or rather cyclonic expansion of the imprisoned gases results. This expansion is upwards, downwards and outwards, following the lines of least resistance. The surrounding atmosphere is at first pushed back with a rush, but simultaneously there is an effort towards readjustment. The superheated hydrogen at once seeks to combine with the cooler oxygen, and in the process of readjustment frequent discharges and flashes of flame are seen which explode the mixture of hydrogen and atmospheric air in combination. The process is now reversed and, instead of expansion, we have immediate contraction and condensation. Water is at once formed and it concentrates around the dust particles and falls in a rain of mud. The reports show that the mud fell, not near the crater, but along the lower part of the mountain.

As soon as the outrushing hydrogen could combine with the oxygen of the air to form water, an immediate contraction followed. A vacuum was formed extending over areas in proportion to the volume of hydrogen ejected, and combined with the atmosphere. Hurricane phenomena on a gigantic scale were at once witnessed. Trees were uprooted and the walls of houses were pulled outwards. The clothes of the victims were torn off. The garments had acted like the screens on the Davy safety lamp—they had prevented the air between body and clothes from combining with the hydrogen, but as soon as the vacuum caused by the combination on their exterior took place they were exploded and torn off by the contained air. The extensive vacuum thus formed might also account for the sudden death of the victims, the instantaneous removal of the atmospheric pressure causing cerebral hemorrhage and paralysis. Autopsies upon the bodies of the victims would have determined the immediate cause of death. If none have been made they might still be made where the bodies were well covered.

In the absence of other demonstrable causes the tidal wave may also be accounted for on the same theory.

Rob't H. Gordon.

Cumberland, Maryland,
June 7, 1902.

SHORTER ARTICLES.

BLACK RAIN IN NORTH CAROLINA.

The 'famous black rain,' so-called by the natives, fell at Louisburg, N. C., the morning of March 15, 1900.

A sample of the water which had been carefully collected came into our hands through the kindness of Professor M. S. Davis, of the Louisburg Female College. An analysis was made:

	Parts per Million.
Total residue	88.00
Loss on ignition	54.00
Non-volatile residue	34.00
Chlorine	19.144
Oxygen consuming power—15 minutes	1.93
Oxygen consuming power—4 hours	2.64
Ammonia—free	.872
Ammonia—albumenoid	.04
Nitrogen as nitrates	.88
Nitrogen as nitrites	none.

About sixty per cent. of the residue was organic matter, largely soot. The chlorine content showed an unusual amount of sodium chloride. The non-volatile residue besides sodium and some calcium gave reactions for traces of iron, manganese, aluminum and zinc. The other constituents indicate ordinary rain water.

No especial phenomena were noted preceding or during the precipitation 'except an unusually black cloud and a heavy downpour of rain, accompanied by a darkness so dense as to necessitate the use of lamps for half an hour.' It had been raining for several days preceding this occurrence and the water collecting in pools out of doors showed a distinct and unusual black color. A number of samples were collected and held as a curiosity. After a few days the water became clear through the settling of a black sediment.

The situation of and amount of fuel burned in the place, as well as the time of the year, preclude accounting for the fluorescent black rain by local contamination, such as observed in numerous cases by Angus Smith and Phipson and lately by Irwin, who examined the snowfall in Manchester, England (*Journ. Soc. Chem. Ind.*, XXI., 533, 1902). While it is well known the unusual impurities in rain, snow, etc., often occur and the sources of contamination may be traced great distances, no opinion is hazarded as to the cause of this phenomenon. All such incidental observations deserve chronicling, as did the black snow which fell in Indiana in January, 1895 (*Monthly Weather Review*, 60, 19), the 'blood rain' reported by Passerine to have fallen at Florence in March of last year (*L'Orosi*, 24, 325), and the 'dust fall' in Europe the same month (reported by Hellmann and Meinardus).

Chas. Baskerville,
H. R. Weller.

University of North Carolina.

THE RANGE OF THE FOX SNAKE.

To THE EDITOR OF SCIENCE: Cope (*Rept. U. S. Nat. Mus.*, 1898, p. 832) gives the range of the fox snake, *Coluber vulpinus* B. & G., as 'distributed over the northwest of the eastern district, not being known from east of Illinois or south of the mouth of the Missouri River.' Dr. J. A. Allen in 1869 (*Proc. Bos. Soc. Nat. Hist.*, 12, 171 ff.) mentioned a specimen of this snake taken in the vicinity of Wenham, Mass., in 1861. Cope apparently overlooked this record. Eckel, in his recently published 'Catalogue of the Reptiles of New York' (Bull. 51, N. Y. State Museum), gives it a doubtful place on the strength of this record of Dr. Allen's.

Aside from this single case, no record has been made, to my knowledge, of the occurrence of this snake in any state east of Illinois with the exception of Ohio. In the vicinity of Sandusky, east and west along the lake, the fox snake is found. On Cedar Point —a tongue of sand twelve miles long and a few hundred yards wide at best—several specimens have also been taken. The specimens from these localities are in the Zoological Museum of the Ohio State University.

Owing to the fact that several species of plants and animals of pronounced western type have been found in this region, it appears that this may form an eastward arm of the zoogeographical as well as the phytogeographical district to the west. Hence, any information as to the occurrence of the fox snake east of Illinois will be welcomed by the undersigned.

MAX MORSE.

OHIO STATE UNIVERSITY.

A PROPOSED AMERICAN ANTHROPOLOGIC ASSOCIATION.

DURING the Convocation Week of 1901–1902, there were meetings of the Section of Anthropology of the American Association for the Advancement of Science, the American Folk-Lore Society, and several other organizations, in Chicago. In connection with these meetings there was, on December 31, a conference of committees on the needs of American anthropology appointed by the Anthropological Society of Washington, the American Ethnographical Society, and the Section of Anthropology of the A. A. A. S. The participants in the conference were Franz Boas, Stewart Culin, Roland B. Dixon, George A. Dorsey, Livingston Farrand, J. Walter Fewkes, George G. MacCurdy, W J McGee, Frank Russell, and Frederick Starr. Although little constructive action was taken at Chicago, the conference resulted in a general feeling that more definite cooperation among American anthropologists would be advantageous.

Subsequently several of the conferees engaged in correspondence pursuant to the deliberations in Chicago, which soon served to bring out and strengthen the feeling that some sort of organization was needful; and in the course of a few weeks preliminary steps were taken toward the formation of an association of American anthropologists of national character. The most important action was the selection of a number of prospective founders of the proposed association, from whom expressions were invited. Most of the anthropologists so addressed have replied, and nearly all of these decidedly favor organization. Accordingly, arrangements have been made for a founding meeting, to be held at Pittsburgh in connection with the meeting of the American Association for the Advancement of Science, in the audience room of Bellefield Church, on Monday, June 30, at 2 o'clock P.M. Provisional arrangements are also under way for a scientific meeting of the new organization in connection with Section H (Anthropology) of the A. A. A. S. on Wednesday, July 2.

The most serious question brought out in the preliminary correspondence and conferences is, Shall the new association be strictly professional or of more general character? With the view of holding the settlement of this question in abeyance pending the completion of the organization, it was thought better by the Chicago conferees to limit invitations to the founding meeting to about forty of the leading anthropologists of the country. The invitations are now being sent out by Dr. George A. Dorsey, of the Field Columbian Museum. W J M.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The American Association for the Advancement of Science holds its fifty-first annual meeting at Pittsburgh from June 28 to July 3, and in affiliation with it a number of scientific societies hold their meetings. Announcements in regard to the meetings will be found in the issue of Science for May 23. Letters in regard to the meeting may be addressed to the permanent secretary, Dr. L. O. Howard, Hotel Schenley, Pittsburgh, Pa., or to the local secretary, Mr. George A. Wardlaw, Post-office Box 78, Station A, Pittsburg.

SCIENTIFIC NOTES AND NEWS.

Dr. William H. Forwood has succeeded Dr. George M. Sternberg as surgeon-general of the army. His services during and since the Civil War have been distinguished, and he is the author of important contributions to military surgery and of papers on natural science. Dr. Forwood is brigadier-general and senior officer in the medical department of the army. His retirement under the age limit will occur next Saturday.

The dinner in honor of Surgeon-General George M. Sternberg, to which we have called attention, occurred in New York on June 13. Addresses were made by Dr. E. G. Janeway, Dr. A. H. Smith, Colonel Henry Lippincott, Dr. William Osler, Major W. C. Gorgas, Dr. John A. Wyeth, Dr. Frank Billings and Dr. W. H. Welch. Dr. Sternberg also spoke.

At its recent commencement exercises Princeton University conferred the degree of LL.D. on Dr. H. F. Osborn, professor of zoology at Columbia University.

President Henry Smith Pritchett, of the Massachusetts Institute of Technology, gave the convocation address at the University of Chicago on June 15.

Dr. J. Walter Fewkes, of the Bureau of American Ethnology, has just returned from a successful ethnologic and archeologic reconnaissance of Porto Rico.

Dr. Frank Russell has brought to a close a year's work in Arizona under the auspices of the Bureau of American Ethnology. Some months were spent in archeologic reconnaissances and surveys; since January he has been occupied with studies of the sociology and mythology of the Pima Indians at Sacaton and elsewhere. Dr. Russell will resume his work in Harvard during the autumn.

Dr. Albert E. Jenks, ethnologist in the Bureau of American Ethnology, sailed from San Francisco on the 15th instant for Manila, pursuant to a transfer of a year to the Philippine service. He will be associated with Dr. David P. Barrows, chief of the Philippine Bureau of Non-christian Tribes.

Assistant Professor Oscar Quick, of the Department of Physics, University of Illinois, Urbana, Illinois, has resigned his position to go into practical electrical engineering work.

The Pathological Institute of the University of Prague will celebrate next year the twentieth anniversary of the directorship of Professor Hlava. A commemorative volume is in preparation.

Mr. E. Cunningham, St. Johns College, is this year senior wrangler at Cambridge.

The Paris Academy of Sciences has sent M. Lacroix, of the Museum of Natural History; M. Rollet de Lisle, the engineer, and M. Giraud, the geologist, to investigate the effects of the volcanic eruption in the Lesser Antilles. They embarked on June 9, and will spend several months on the islands.

The Loubat prize for 1902 has been awarded by the Swedish Royal Academy of Literature, History and Antiquity to Mr. C. V. Hartman for his publications concerning his archeological and ethnological researches in San Salvador and Costa Rica.

In honor of the late Alpheus Hyatt a memorial fund is being collected for field lessons in natural history. Professor Hyatt was greatly interested in extending the teaching of natural history to the schools and this memorial appears to be especially appropriate. While the fund will be administered by a board of trustees at Boston contributions from Professor Hyatt's former pupils or friends, wherever living, will be welcome. The president of the trustees is Professor William H. Niles, of the Massachusetts Institute of Technology, and the treasurer, to whom subscriptions may be sent, is Mr. Stephen H. Williams, 2 Tremont street, Boston, Massachusetts.

DR. WYETH JOHNSON, recently appointed professor of hygiene at McGill University and dean of the Medical School, died at Montreal, on June 19.

DR. RICHARD BURTON ROWE, of the U. S. Geological Survey, died of consumption in the hospital at Los Angeles, Cal., on May 26, at the age of thirty years. Dr. Rowe was a graduate of Union College and Johns Hopkins University. His home was at Clarksville, Albany County, N. Y.

MAJOR OSCAR CHAPLIN FOX, since 1873 examiner in the U. S. Patent Office, and a fellow of the American Association for the Advancement of Science, died on June 7, at the age of seventy-two years.

THE Rev. Doctor Anson Judd Upson, chancellor of the University of the State of New York, died on June 15, in his seventy-ninth year.

CONGRESS has just made an additional appropriation of $75,000 for the buildings of the National Bureau of Standards. The cost of the buildings as now planned is $325,000.

HERR BECK-GAMPER has given 750,000 francs to the Zoological Garden at Basel.

THE Duc de Chartres, in memory of his son, Prince Henry, has given the Paris Geographical Society 11,000 francs, the interest of which shall be given every three years for a journey for economic study and geographical exploration in Asia.

M. HENRI SCHNEIDER gave before his death $7,000 to the French Society of Civil Engineers for seven prizes to be awarded for the best books in different departments of engineering published in France during the last forty years. The books entered for competition must be received by the society not later than the end of the present month.

THE bill transferring certain forest reserves to the Department of Agriculture has been defeated in the House by a vote of 100 to 70.

ATTORNEY-GENERAL DAVIES has decided that the Cornell School of Forestry has not violated any provisions of law on the land held by it in the Adirondack preserve, and he has made public an opinion in which he holds that there exists no cause for the beginning of an action to dispossess Cornell University from lands which the college holds for forestry purposes.

THE annual *conversazione* of the Institution of Civil Engineers was held on June 4. Mr. Charles Hawksley (president), and Mrs. Hawksley, supported by Sir John Wolfe-Barry, Sir Benjamin Baker, Sir Frederick Bramwell, Sir William Preece, Sir Douglas Fox, Sir Alexander Binnie, and Sir G. Molesworth (members of the council) received about 1,500 guests.

W. S. CHAMP, secretary of the Baldwin-Ziegler Arctic expedition, and Dr. G. Shurkley, of New York, started on June 13 for Tromsö, Norway, whence they will sail on July 1 on the *Frithjof* for Franz Josef Land to take coal to Mr. Baldwin's ship, the *America*, and obtain news of the explorer. Mr. Champ expects to find the *America* in about 82 degrees. If Mr. Baldwin has succeeded in his dash to the pole he will be brought back. Otherwise the *Frithjof* will leave a well equipped sledge party to search for Mr. Baldwin. The *Frithjof* will return on October 1 at the latest.

PROFESSORS R. A. S. REDMAYNE and T. Turner, who hold respectively the chairs of mining and metallurgy in the University of Birmingham, are at present in America investigating our technological schools with a view to the arrangement of their departments at Birmingham. In the Montreal daily *Star*, a copy of which a correspondent has sent us, Professor Redmayne is quoted as saying: "In no part of England, nor anywhere on the continent, in fact, can you find a school of mining or a department of metallurgy in any university that can in any way compare with those to be found in Canadian and American universities. Strange to say, these departments in the universities of the old country are so incomplete that up to the present it has been found necessary, if one wanted to obtain a thorough technical training, to come to America. To change the present condition of affairs in England is the object of our present visit."

At a meeting of the Zoological Society of London on June 3 Mr. William Sclater made some remarks on the present condition and future prospects of the zoological museums of South Africa, altogether eight in number, most of which he had recently visited.

The city of Waukesha, Wisconsin, as a result of a condition of a recent election, has purchased the Cutler property in that city for use as a library and park site to enclose and preserve the three prehistoric mounds situated thereon. The efforts of the Wisconsin Natural History Society were largely instrumental in bringing about this result.

The Canadian Electrical Association held its twelfth annual convention at Quebec on June 11, 13 and 14.

An International Navigation Congress will be held at Düsseldorf from June 29 to July 5.

The American Roentgen Ray Society will hold its next meeting in Chicago on December 10 and 11, under the presidency of Dr. G. P. Girdwood, of Montreal.

The program for the Section of Science at the approaching meeting of the National Educational Association is:

'President's Address': W. H. Norton, Professor of Geology, Cornell College, Iowa.

'The Educational Value of Museums': Oliver C. Farrington, Field Columbian Museum, Chicago.

'The Projection Microscope; its Possibilities and Value in Teaching Biology': Professor A. H. Cole, Lake High School, Chicago.

'The International Geographical Congress to be held in Washington under the Auspices of the National Geographic Society, 1904': Gilbert H. Grosvenor, Managing Editor *National Geographic Magazine*, Washington.

'Laboratory Courses in Physics': Frank M. Gilley, High School, Chelsea, Mass.

'The Value of Physiography in the High School': Professor J. A. Merrill, State Normal School, West Superior, Wisconsin.

'Federal Facilities for Education': Dr. W J McGee, Ethnologist in charge Bureau of American Ethnology, Washington.

We announced last week a civil service examination to fill twelve vacancies in the position of aid in the U. S. Coast and Geodetic Survey. We have received a copy of a letter by Mr. O. H. Tittmann, superintendent of the Survey, containing the following further explanation: The rank of aid is the lowest or entering rank leading to the position of assistant to the superintendent. The Coast and Geodetic Survey is engaged in a great variety of duties and its operations extend over a vast range of territory. The aids, like the assistants, are subject to assignment either as chiefs of party or subordinate officers on parties engaged in the determination of the magnetic elements, in secondary triangulation and astronomical determinations for the control of topographic and hydrographic surveys, in primary triangulation and the corresponding astronomical determinations, in topographic surveying along the coast and in hydrographic surveys in the bays or harbors and in the open sea. The steamers and sailing vessels belonging to the Survey are commanded by these members of the permanent field force. During the intervals between field seasons assistants and aids are subject to assignment to office duty in Washington, or in one of the sub-offices at Seattle, San Francisco, Honolulu or Manila. Nearly all administrative positions in the office at Washington, from that of chief of division to the highest rank, are open to and are now filled by assistants. The duties of the field officers take them to all parts of the United States, including Porto Rico, Alaska, Hawaii and the Philippines. The members of the permanent field force have, therefore, a very wide range of duties as surveyors engaged in the highest grades of surveying, as navigators and as scientists, and have a rare opportunity for extensive travel and acquaintance with the world. The aid is subject to assignment to any duty required of any other officer of the permanent field force. In general the exigencies of the service place the aids so promptly in responsible positions that there is an abundant opportunity for a man of exceptional ability to become known. Aids are appointed at a salary of $720 per year. The next step in the line of promotion is to the salary of $900 as aid, and thence to assistant at $1,200, and then upward by steps of $200 each. These statements of salary are misleading unless taken in connection with the fact that necessary traveling expenses incurred in the line of duty are paid by the government, and that in addition to his salary he is paid an allowance for subsistence to cover the ordinary living expenses while on field duty. During this period the allowance for subsistence is from $1.00 a day for an officer living on shipboard or in camp in quarters furnished by the government, to $2.50 a day for a chief of party living at a hotel or other quarters not furnished by the Government. All appointments to the position of aid are made from a Civil Service examination.

The Sixth Annual Report of the New York Zoological Society is most creditable to the Society in general and the director in particular. It not only shows very rapid progress in the laying out of the grounds and the erection of new buildings, but progress in the care of animals and in the control of disease among them; this in spite of the loss of several anthropoid apes. The death of these animals was found to be caused by an infusorian, *Balantidium coli,* introduced with the Galapagos tortoises, and harmless to them, while fatal to the large apes. The diseases of the animals are discussed at length in the reports of the veterinarian and pathologist, and the statement is made that little loss has been caused by tuberculosis, although this usually causes a large proportion of the deaths among animals in captivity. Mr. Ditmars gives an interesting account of the giant tortoises from the Galapagos, Mr. Beebe describes the 'Success of the Indoor Flying Cage,' Madison Grant tells of 'The Society's Expedition to Alaska,' and Mr. Loring presents some 'Notes on the Destruction of Animal Life in Alaska,' and gives an annotated list of 'Mammals and Birds observed in Southern Alaska in 1901.' The report is well illustrated and contains articles both of scientific value and of interest to the general reader.

As a result of a series of experiments begun at Clemson College in 1901 and brought to a successful completion in the laboratories of the New York Botanical Garden Dr. Alex. P. Anderson has developed a method by which, with the application of heat to starch grains and to air-dry starch in many forms, the granules or particles are expanded to many times their original dimensions, being fractured into innumerable fragments during the process. As a result of this treatment a grain of rice is expanded to eight or more times its original volume, while still retaining its original form. Other cereals exhibit similar behavior. The process is applicable to nearly all starchy seeds and starchy substances, greatly increasing their nutritive availability. The products obtained are pleasant to the taste, and the process may be varied to produce a great variety of flavors with any given cereal. Furthermore the material prepared in this manner is absolutely sterilized and may be preserved or stored for long periods. The approval the products have met from food and chemical experts suggests that the process may prove of great economic and commercial value.

THE London *Times* states that a London auctioneer has sold a collection of birds' eggs, among which was included the final portion of the collection of the late Mr. Philip Crowley, and also a collection from the cabinets of Mr. H. Noble. The most important lot in the sale was probably the finest known egg of the extinct moa, from New Zealand, which, however, did not reach the reserve price at £200. The last egg of this bird was offered at Stevens' about 20 years ago, and this was bought in at 200 guineas; it was returned to New Zealand, but eventually passed into the possession of an English collector at about 250 guineas. An egg of the Æpyornis *maximus,* the largest specimen ever offered, realized 38 guineas, and two eggs of the pectoral sandpiper, one from Alaska, £8 18s. 6d. These are the only eggs of this bird ever offered for sale in England. Four exceptionally large eggs of the golden eagle varied from 55s. to 75s. each.

UNIVERSITY AND EDUCATIONAL NEWS.

At the commencement exercises of the University of Pennsylvania, Provost Harrison announced that Mr. Joseph Wharton, founder of the Wharton School of Finance and Economy at the University, had increased his endowment of the school from $200,000 to $500,000.

Pennsylvania State College has received $100,000 from Mr. Andrew Carnegie for a library; $60,000 from Mr. and Mrs. Charles M. Schwab for an auditorium; and $20,000 from Mr. James Gilbert White for the establishment of a fellowship and three scholarships.

The sum of $100,000 has been collected for Smith College, thus securing the $100,000 promised by Mr. John D. Rockefeller.

A friend of the Massachusetts Institute of Technology, whose name is withheld, has given to that institution $5,000 a year for three years, to be devoted to investigation and instruction in sanitary science and the sanitary arts, especially the purification of sewage and water, and the disposal of garbage and other wastes of modern life. The work to be done will be under the direction of Professor W. T. Sedgwick, the head of the biological department of the Institute, and formerly biologist to the State Board of Health of Massachusetts.

Mrs. Sarah A. Rand has bequeathed $5,000 to Radcliffe College and the residue of her estate to the Boston Museum of Fine Arts.

Plans to expend $1,200,000 on a secondary school quadrangle at the University of Chicago have been announced by President Harper. The new group, of which the school of education building already in course of erection will be part, will include several buildings, all of which will be devoted to secondary education. Ground has been broken for the new manual training schools, and the other structures will be built as the expected endowments are received.

Franklin and Marshall College, Lancaster, Pa., dedicated its new Science Hall on June 11, when Professor Edgar F. Smith, of the University of Pennsylvania, delivered the chief address. The building was erected at a cost of about $80,000.

The University of Sydney, New South Wales, will celebrate in September its fiftieth anniversary.

Professor George H. Denny has been installed as president of Washington and Lee University. He graduated from Hampden-Sydney College in 1891, and has been professor of Latin at Washington and Lee University since 1899. The addresses of greeting at the installation included speeches by President Remsen, of the Johns Hopkins University, and President Venable, of the University of North Carolina.

Professor Charles W. Needham, dean of the Law School of Columbian University, has been elected president of the institution.

Mr. Alexander C. Humphreys has been elected president of the Stevens Institute of Technology, in succession to the late Henry Morton. Mr. Humphreys is a gas engineer and an alumnus and trustee of the institute.

The McGill University medical faculty has recommended the Board of Governors to appoint Dr. R. F. Ruttan as professor of chemistry, in succession to Dr. Girdwood, resigned, and Professor McBride, Strathcona professor of zoology in the arts faculty, to a like chair in the medical faculty.

At Cornell University Dr. H. Ries has been appointed to an assistant professorship in geology, and Dr. P. A. Fish to an assistant professorship in comparative physiology.

At the University of Colorado, in Boulder, Mr. H. Chester Crouch, of Oswego, New York, a graduate of Cornell University, has been appointed assistant professor of mechanical engineering in charge of the department. President James H. Baker has leave of absence for four months, during which time he will travel in Europe. Dr. Francis Ramaley, of the department of biology, will be acting president until his return.

Mr. Edward Gordon Duff, M.A., Oxford, of Wadham College, has been elected Sandars reader in bibliography at the University.

Mr. Charles G. Barkla has been elected to the Oliver Lodge fellowship, recently founded at University College, Liverpool, to promote research in physics.