The successive sheets were revised by him and printed off under his direction; but at his death some intended articles remained unwritten, although everything up to them had been revised and printed off. Professor Joly testifies in his preface that he has found extraordinary accuracy both of matter and of printing in the first edition. To the new edition he has added a preface, an index, an analysis of each article in the table of contents, footnotes and an appendix containing more lengthy notes on the following subjects: 'Quaternion Determinants,' 'Miscellaneous Properties of Two Linear Vector Functions,' 'The Strain Function,' 'On the Specification of Linear Vector Functions,' 'On the General Linear Transformation in Space,' 'On the Theory of Screws,' 'On Finite Displacements,' 'On the Kinematical Treatment of Curves,' 'On the Kinematical Treatment of Surfaces,' 'On Systems of Rays,' 'On Hamilton's Operator ∇.'

It was Abel who said that if one wished to make progress in mathematical science he ought to study the original work of the master rather than the presentations of his pupils. This maxim applies especially to quaternions; and for facilitating the study of Hamilton's great work the Printing Board of Trinity College, Dublin, and the editor, Professor Joly, deserve the thanks of the mathematical world.

ALEXANDER MACFARLANE.

SOCIETIES AND ACADEMIES.

THE RESEARCH CLUB OF THE UNIVERSITY OF MICHIGAN.

THE Research Club of the University of Michigan was organized two years ago, its membership being made up from the University Faculties, and its aim being the promotion of research. During the year just closed, the Club has met six times, and its proceedings may be briefly summarized as follows:

At the first meeting, held in October, 1900, the theme for discussion was 'The Promotion of Research at the University of Michigan.' Dr. Vaughan, President of the Club, addressed the members on the organization and objects of the Club, and closed with remarks on the topic of the evening. Professors Wenley, Ziwet, Adams and Reighard spoke by appointment, and they were followed *ex tempore* by Dr. Hulett, Dr. Bigelow and Dr. Dock.

At the second meeting, November, 1900, the speakers were Professors Hempl and Newcombe. Professor Hempl spoke on the formation of dialect districts in the United States, showing with the help of charts the boundaries of various dialectic differences. The speaker gave concrete examples of variation in the use and pronunciation of words and phrases, and made some attempt to trace the historical development of these variations.

Professor Newcombe narrated his experiments on the sensitive curves made by roots in response to the streaming of water, and in response to contact with a foreign body. It was shown that about one-half of the thirty-three species of plants tested are sensitive to the water-current, and that of the four water-plants used, none is sensitive. So far as tested, all those plants responding to the water-current responded to the contact of a foreign body, and those not responding to one did not respond to the other. Hence it is supposed, though not demonstrated, that the response in both cases is response to one-sided pressure. A summary of these results may be found in SCIENCE, XIII. (1901), p. 250.

The third meeting came in January, 1901. Professor Gomberg detailed the experiments which led to his discovery of the trivalency of carbon. Accounts of this work may be found in *Jour. Amer. Chem. Soc.*, **22**, 757; *Ber. d. d. Chem. Gesellsch.*, **33**, 3150; *Amer. Chem. Jour.*, **25**, 317. Dr. H. S. Jennings stated his results in studying the reactions of infusoria to external stimuli, illustrating his summary with experiments, made visible to all present by projection with a lantern. The researches of which Dr. Jennings gave an account have been published in full in various journals, and an abstract appeared in SCIENCE for January 11, 1901 (XIII., 74), in the report of the Zoological Journal Club of the University of Michigan.

The February meeting listened to papers by Dr. George Dock and Professor W. B. Pillsbury. Dr. Dock described the method of teaching internal medicine in the University. The limited time in the medical course makes it

difficult for undergraduates to do more in the way of research than to work out some original detail. In this work, they make extensive use of the laboratory method, and the effort is made to require students to think for themselves. The paper closed with the citation of subjects of investigation followed in the medical clinic. Professor Pillsbury presented a summary of a paper entitled 'Do the Sensations of Movement Originate in the Joints?' The narration of his experiments showed that a current through the ankle or elbow was as effective in reducing the sensitiveness of knee or elbow as currents through the joints in question. This fact, he stated, can only be explained if the sensory endings in the tendon or muscle are the seat of the sensation, and not the joints as is usually claimed.

In the March meeting Dr. Warthin and Dr. Hulett presented papers. Dr. Warthin spoke on 'A Contribution to the Normal Histology and Pathology of the Hemolymph Glands' (preliminary report). In this paper the occurrence of glands containing blood-sinuses instead of lymph-sinuses is for the first time shown to be constant in the human body. The distribution of these glands, their minute structure, their hemolytic function under normal conditions, etc., are described. Two types of these glands—splenolymph and marrowlymph glands—are found to occur. In a number of cases of fatal anemia, pathological changes were found in these glands, showing conclusively that they may become centers of red blood-cell formation.

Dr. Hulett presented a report of his measurements of 'The Relation Between Surface Energy and Solubility.' The theoretical relation between surface tension and solubility was discussed, and experimental data given to show that the solubility of a substance depends upon the curvature of the surface—*i. e.*, the finer the state of division the more soluble (t constant). The solubility of gypsum was increased 19 % by decreasing the size of the particles from 2 μ to 0.3 μ; barium sulphate showed an increase of 100 % in solubility, and mercury oxide 300 % over that of the normally saturated solutions.

At the last meeting, held the 29th of May, Professor Lloyd read a paper bearing the title 'Some Unscientific Reflections upon Science.' The paper was vigorously discussed, some of those present thinking that the attitude of scientific men had been unfairly portrayed, while others supported Professor Lloyd. This paper is soon to appear in full in SCIENCE. At this meeting also, Professor E. D. Campbell detailed in a highly interesting manner his researches on the microscopical and chemical composition of steel. His paper gave a comparison of the heat of formation, and the action of nitric acid and of iodine on cementite, one of the constituents of high carbon steel, and on the pure carbide of iron isolated from pearlite. From these comparisons the author concludes that free cementite is not only not identical with the carbide of pearlite, as is usually assumed, but is probably not a carbide at all, but a solid solution of carbon in iron.

FREDERICK C. NEWCOMBE,
Secretary.

THE TEXAS ACADEMY OF SCIENCE.

DURING the half year ending with June, this organization held four meetings in the Chemical Lecture Room of the University of Texas. On January 18, Dr. William Morton Wheeler, professor of zoology in the University, lectured upon 'The Relation of Ants to other Living Organisms'; on March 23, Dr. William L. Bray, professor of botany, lectured on 'Texas Forests: their Present Condition and their Future Management'; and on April 5, Dr. William B. Phillips, the lately appointed director of University Mineral Survey, lectured on 'Texas Petroleum.' The lectures of Messrs. Wheeler and Bray were illustrated by a liberal use of lantern slides.

The program of the annual meeting, held on June 10, was as follows: 'Contributions of the Nineteenth Century to Education,' William S. Sutton, M.A., professor of the science and art of education in the University of Texas.

'Rice Irrigation in Texas,' Thos. U. Taylor, M.C.E., professor of applied mathematics in the University of Texas.

'Texas Railway Stock and Bond Law,' R. A. Thompson, C.E., expert engineer to the Texas Railroad Commission.

'Texas Minerals and Mineral Localities' (by

title), Frederic W. Simonds, Ph.D., professor of geology in the University of Texas.

'Notes on the Yellow Oxide of Mercury,' E. P. Schoch, M.A., and O. W. Wilcox, school of chemistry, University of Texas.

Professor Sutton's paper was a thoughtful exposition of the subject—'Contributions of the Nineteenth Century to Education'—though necessarily brief. The closing paragraph, in the form of a summary, was as follows: "In conclusion, let us consider for a moment the question, What is the significance of all these contributions which the last one hundred years have made to education? Upon what principle can be explained the accomplishment of a task so stupendous as to involve, first, the most radical changes with respect to the aim in education; second, the vast expansion of the culture-material to accomplish this aim; third, the discovery of scientific method in instruction; fourth, the provision for the professional training of teachers; fifth, the organization and partial development of gigantic systems of public instruction at public expense; sixth, the increase of number of the learned professions by recognizing the dignity of applied sciences; and lastly, the extension of the privileges of education to the child in the kindergarten, and to the parent in the home? There can be but one answer to this question—it is the spirit of real humanism, which is the distinctive characteristic of the nineteenth century, a spirit which through the reign of reason seeks to bring all men to a knowledge of the truth, and which has for its ultimate purpose the complete physical and spiritual enfranchisement of the human race."

Mr. Thompson in discussing 'The Texas Railway Stock and Bond Law,' called attention to the fact that Texas is the only State in which the issuance of railway stocks and bonds is controlled by the government, and also that it is the only one which has prescribed an absolute basis for the valuation of railway properties.

The Stock and Bond Law declares that the issuance and execution of all railway securities are 'special privileges' subject to the absolute control of the State; and that no indebtedness shall be authorized beyond the 'reasonable value of property' to be fixed by the Railroad Commission in accordance with actual cost. Railways existing at the time of passage of the law were valued at the estimated cost of reproduction.

The causes that led up to the enactment of the law were discussed, and it was shown that the contention by investors in railway stocks and bonds, that they should be entitled to charge freight and passenger rates sufficient to earn a fair rate of interest on their holdings, and the support of the Courts in the matter, led the State to limit the issuance of such securities, and to absolutely prohibit the current practice of 'watering' stocks and bonds.

It was shown from the reports of the Railroad Commission that the average amount of stocks and bonds outstanding against the railways of Texas, under the effect of this and other laws, had been reduced from $43,961 per mile in 1894 to $36,926 per mile in 1900. As the Stock and Bond Law continues in effect this will be further reduced, thus permitting a larger per cent. of the net earnings to be used in the upbuilding of the roads and guaranteeing safer investments to the purchasers of railway securities. Notwithstanding the restrictions of the law, railway building in Texas is progressing at a rapid rate—building for purely speculative purposes is checked and legitimate construction promoted. In 1901 it is thought that Texas will easily lead the States of the Union in miles of new railway.

The following notes on the red oxide of mercury were presented by Messrs. Schoch and Wilcox:

"The yellow oxide of mercury has been carefully examined in the laboratory of the school of chemistry of the University of Texas, with a view to clearing up disputed points. By heating up to 200°C. and weighing the water evolved only 0.6% was obtained, which invalidates the statements of Walker and Schaffner that the substance is mercuric hydroxide—a statement made on the basis of results obtained by heating the substance in the open air and reporting the loss as water, and corroborates the work of Siewert. The substance is distinctly crystalline; its specific gravity is 10.6 as determined by Mr. J. M. Kühne, while that of the red oxide is 11."

Upon the report of Messrs. A. M. Ferguson

and John K. Prather, tellers, President Harper announced that the following persons had been duly elected officers of the Academy for the year 1901–1902: President, Professor James C. Nagle of the Agricultural and Mechanical College of Texas, College Station; Vice-President, Dr. Henry Winston Harper, of the University of Texas; Treasurer, Mr. R. A. Thompson, Engineer to the State Railroad Commission; Secretary, Dr. Frederic W. Simonds, of the University of Texas; Librarian, Dr. William L. Bray, of the University of Texas; Other Members of the Council, Hon. Arthur Lefevre, State Superintendent of Public Instruction, and Professors Taylor and Wheeler, of the University.

FREDERIC W. SIMONDS,
Secretary.

THE TORREY BOTANICAL CLUB.

AT the meeting of the Club on May 24, 1901, the scientific program consisted of a paper by Dr. H. M. Richards on 'The Botanical Establishments at Buitenzorg and Tjibodas in Java,' illustrated by numerous photographs, including views of the entrance to the botanic garden and of species growing within, of large lianas a foot in diameter, of the nutmeg, jackfruit, etc., of a tapioca plantation, beautiful treefern groves with alsophilas 40 feet high, etc. Dr. Richards described his journey by train from Batavia 40 miles to Buitenzorg among the foothills of the western mountains. The Botanical Garden of Buitenzorg is at an elevation of over 900 feet, and therefore much cooler than the coast lowlands, the thermometer rarely going below 80° or above 90° F.; rain falls almost every day and almost uniformly through the year; the forenoon is bright and clear; the conditions for plant growth are very much as in a hothouse. A smoldering volcano rises on one side and an extinct one on the other, with a very variable river between.

The history of the Garden dates from Sir Stamford Raffles, British governor, who made a picturesque park about 1811 about his palace, of which the Garden shows some remnants. The Rafflesia, which perpetuates his name, is but occasionally to be seen, and although the Garden endeavors to maintain examples of growth, none were to be had at the time of Dr. Richards' visit. Since the present directorship, about 1880, the Garden has been greatly stimulated. Dr. Lotze, formerly at the Johns Hopkins University, is now one of the staff there. The eight laboratory tables for foreign workers were well filled. Much valuable work has been done of immediate agricultural utility; it is here that the *Cinchona* was acclimated from South America to replace the coffee industry, the coffee plants having been destroyed by a fungus. Experiments toward finding a new rubber supply are in progress, and others to improve vanilla and cocaine production. The Malay workmen who fertilize the vanilla plant by hand prove very skilful. About 30 Europeans and 200 natives form the garden force. In the Botanical Garden proper the orders are not grown in exact sequence, but are grouped and marked off by letters; two specimens of each species are grown; one at least of these is labeled; if grown away from its congeners that fact is indicated by use of a red label. Many screwpines which belong to the salt or brackish water of the coast grow well here in the garden soil. The palm collection is one of the largest in the world; notable features are its specimens of *Areca* and of *Livistona*. Down by a brook is a fine *Casuarina* collection, the Javanese species of which forms large forests on the upper hills resembling northern larch forests. The *Ficus* group is abundant and supplies the favorite shade tree for Javanese streets. Orchids hang especially from trees of the leguminous type, as *Amherstia*, *Cæsalpinia*, etc. These trees are very like candelabra in direction and so expose a reduced surface to the excess of light.

The mountain-garden at Tjibodas, at an elevation of about 4,500 feet, affords the necessary complement to the botanical garden proper. Dr. Richards found it cool enough after the afternoon rain to make a fire very welcome. Good potatoes are raised there, and on the journey up one passes paddy-fields and tea-plantations, including that from which came the Javanese villagers at the Chicago fair. A great jungle of 700 acres extends up to the mountain top, through which the ascent was taken at 3 A. M. by torchlight, to get the sunrise view. Here tropical oaks develop

into dense balls, epiphyte ferns are in abundance, fallen trunks are covered with moss, and the path through the jungle chokes up so quickly that it has to be cut open often. The jungle is said to contain 1,500 species of trees. The Malays are very keen in perceiving distinctions, and recognize two species of oaks there which the botanists have not yet discriminated. On the heights the aspect becomes more European, *Viola*, *Ranunculus*, *Primula*, *Lonicera*, *Lobelia*, *Oxalis*, etc., appear, and Wallace explained this by supposing these northern forms were pushed south by a glacial climate and on the retreat of the ice they themselves retreated to the mountains.

EDWARD S. BURGESS,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of the Academy of Science of St. Louis, on the evening of June 3, 22 persons present, the following subjects were presented:

A paper by Dr. Gellert Alleman, on 'The Action of Alcohol on Certain Isomeric Diazo Compounds,' and one by Dr. G. Hambach, entitled 'A Revision of the Blastoideæ,' were presented by title.

Mr. Wm. H. Roever, of Washington University, read a paper on 'The Effect of the Earth's Rotation upon Falling Bodies,' in which he showed that a body falling from a great height has a southward deviation in the northern hemisphere and a northward deviation in the southern hemisphere. The deviation is given by the formula—

$$\Delta = h\left[\frac{\left(1+\frac{h}{R}\right)^3 K \sin\phi\cos\phi}{1-\left(1+\frac{h}{R}\right)^3 K\cos^2\phi} - \frac{1}{\left(1+\frac{h}{R}\right)}\cdot\frac{K\sin\phi\cos\phi}{1-K\cos^2\phi}\right],$$

in which h is the height through which the body falls, R the radius of the earth (assumed spherical), ϕ the latitude of the place of observation, K the numerical fraction $\frac{1}{289}$ and Δ the deviation. If h and R are given in feet, Δ is in feet.

For $h = 578$ feet and $\phi = 45°$, $\Delta = .00133$ inch.

Mr. G. Pauls presented a number of specimens collected at Eureka, Mo. He exhibited a large number of galls on hickory, maple and oak leaves, commenting on the remarkable variety of the forms of galls made by the minute insects. He had bred a good many of these insects, and found that in successive years a good many different forms came from these galls.

WILLIAM TRELEASE,
Recording Secretary.

CURRENT NOTES ON PHYSIOGRAPHY.

NEW MAP OF THE MISSISSIPPI.

THE 'Preliminary Map of the Mississippi River from the mouth of the Ohio River to the head of the Passes,' published by the Mississippi River Commission (1881–1885, 32 sheets, one inch to a mile), is now to be supplemented by a new edition, of which 13 sheets are issued, bearing in red overprint the changes wrought by the river in about fifteen years. These new sheets are without question the most instructive exhibition of river work, quantitatively determined, yet published in this country; for a river of the first magnitude they have no rival in the world. They deserve to be widely known not only among engineers for whom they were primarily constructed, but among geographers and teachers to whom they convey much information. The general behavior of the meandering river may be inferred from the maps of the earlier edition, from which it appears that the meander system slowly moves down the valley, because the thread of fastest current, thrown toward the outer side of every curve, is therefore delivered to the down-valley side of every tangent or 'crossing' (so called because river boats must there cross the river obliquely in following the channel of greatest depth); and that the meander belt included between tangents drawn outside of the curves slowly widens as the curves increase in radius and arc until it here and there suddenly collapses when a curve is cut off. It may be noted in passing that it is for this reason that the abandoned curves—the ox-bow lakes—are frequently of larger radius than the average of the existing curves. The